Advanced analytics strategy formulation

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Abstract

Despite the high potential impact of advanced analytics on the performance of businesses around the world, its uptake and application in an integrated and strategically aligned manner has been limited. This problem is more pronounced with specific reference to optimization. Optimization methods lag behind other analytical methods such as data visualization and predictive models in terms of their level of adoption in organizations.

This research suggests that part of the problem of limited application and integration lies in an overall inability of companies to develop and implement an effective advanced analytics strategy. The primary objective of this research is therefore to establish an approach for the development of an advanced analytics strategy for a company. Due to the absence of well described examples or published research on the subject it was necessary to generate insight and knowledge using a research approach that allowed for the development, testing, and improvement of a strategy over multiple cycles. Such a research approach presented itself in the form of action research.

An initial advanced analytics strategy was developed for one of the subsidiary companies in a group of companies. The subsidiary company specializes in the importation, distribution, and marketing of industrial fasteners and has branches throughout South Africa. The strategy document was presented to the senior decision makers in the holding company for evaluation. The feedback from the evaluation was used to formulate changes to the initial strategy aimed at improving its alignment with the decision makers' thinking on advanced analytics and increasing the probability of its implementation. The suggested changes from the first research cycle were used to define the second cycle strategy framework. The second cycle strategy framework included a strategy development process that consisted of three main steps:

- Establishing business focus and relevance which included an assessment of the value creating potential of the business, identifying and prioritizing of value creating opportunities, and an assessment of key underlying decision processes,
- Developing business relevant concept applications which included determining their potential value impact and creating a ranked pipeline of decision optimization applications.
- Selecting concept applications and moving them into production.

The strategy development process was informed by a number of different models, methods and frameworks. The most important model was a detailed valuation model of the company. The valuation model proved to be invaluable in identifying those aspects of the business where an improvement will result in the highest potential increase in shareholder value.

The second cycle strategy framework will be used to develop an improved version of the advanced analytics strategy for the researched company. Moreover, the generic nature of the framework will allow for it to be used in the development of advanced analytics strategies for other companies

Uittreksel

Ten spyte van die potensieel omvangryke impak van gevorderde analitiese tegnieke op die prestasie van besighede wêreldwyd, is die toepassing en strategiese integrasie daarvan beperk. Hierdie probleem is nog meer sigbaar wanneer die aanwending van optimeringsmetodes oorweeg word. Die mate waarin optimeringsmetodes deur besighede aangewend word, is heelwat laer as ander analitiese metodes soos data visualisering en vooruitskattingsmodelle.

Hierdie navorsing plaas 'n groot gedeelte van die probleem voor die deur van besighede se onvermoë om effektiewe gevorderde analitiese strategieë te ontwikkel en te implementeer. Die primêre doel van die navorsing is gevolglik om 'n benadering tot die ontwikkeling van 'n analitiese strategie vir 'n maatskappy voor te stel. In die lig van die afwesigheid van gepubliseerde voorbeelde of soortgelyke navorsing op hierdie onderwerp moes insig en kennis gevolglik bekom word deur die aanwending van 'n navorsingsbenadering wat die navorser in staat gestel het om 'n voorgestelde strategie te ontwikkel, te toets en te verbeter oor verskeie navorsingsiklusse. Die navorsingsbenadering wat gebruik is staan bekend as aksienavorsing.

Die eerste gevorderde analitiese strategie is onwikkel vir een van die filiaalmaatskappye in 'n maatskappygroep. Die filiaalmaatskappy spesialiseer in die invoer, verspreiding, en bemarking van industriële hegstukke en het takke regoor Suid Afrika. Die strategie dokument is voorgelê aan die senior besluitnemers van die houermaatskappy vir oorweging. Op grond van hul terugvoer is veranderings aan die strategie aangebring ten einde hul benadering tot gevorderde analitiese tegnieke te akkommodeer en om die waarskynlikheid van implementering daarvan te verhoog. Die voorgestelde veranderings is gebruik om 'n strategiese raamwerk vir die tweede navorsingsiklus te definieer. Hierdie raamwerk sluit 'n strategiese ontwikkelingsproses in wat bestaan uit drie hoofstappe:

- Vestiging van besigheidsfokus en relevansie wat insluit 'n oorweging van die waardeskeppingsvermoë van die maatskappy, identifisering en prioritisering van waardeskeppingsgeleenthede en die oorweging van die onderliggende besluitnemingsprosesse,
- Ontwikkeling van besigheidsrelevante konsep oplossings wat insluit die bepaling van die potensiële waarde impak en die skepping van 'n ranglys van besluitoptimeringsoplossings, en
- Die verskuiwing van geselekteerde oplossings na 'n produksie omgewing.

Die strategiese ontwikkelingsproses maak gebruik van verskeie modelle, metodes en raamwerke. Die belangrikste model was 'n gedetaileerde waardasiemodel van die maatskappy. Die waardasiemodel was instrumenteel in die idenfikasie van die aspekte van die maatskappy waar 'n verbetering die grootste bydrae kan maak tot die skepping van aandeelhouerswaarde.

Die tweede siklus strategiese raamwerk sal aangewend word om 'n verbeterde analitiese strategie vir die nagevorsde maatskappy te ontwikkel. Die generiese aard van die raamwerk sal 'n gebruiker daarvan in staat stel om 'n gevorderde analitiese strategie vir ander maatskappye te ontwikkel.

Declaration

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List of Acronyms

AR: Action Research

CPM: Critical Path Method

DCF: Discounted Cash Flow

EOQ: Economic Order Quantity

ERP: Enterprise Resource Planning

IC: Invested Capital

INFORMS: Institute for Operations Research and the Management Sciences

NOPLAT: Net Operating Profit Less Adjusted Taxes

PERT: Program Evaluation and Review Technique

ROIC: Return on Invested Capital

ROE: Return on Equity

SME: Small to Medium Enterprise

WACC: Weighted Average Cost of Capital

CHAPTER 1

Introduction

Contents

1.1 Background

Despite an increasing trend of embracing advanced analytics, few businesses are able to effectively apply analytics to improve their decision making and create an analytics-based competitive advantage [18, 2, 23]. Operations research is faced with an additional challenge. Optimization methods, which are the main class of methods in operations research, lag behind other analytical methods such as data visualization and predictive models, in terms of their adoption in organizations [27]. When considering different approaches to creating a sustainable competitive advantage most business leaders do not even consider optimization methods as an alternative [40].

It is important to have a clear common understanding of the definition of advanced analytics and its relationship with operations research. In 2011 Liberatore and Luo [28] conducted research among the membership of INFORMS to get a better understanding of the membership's view on the proposed expansion of INFORMS into the field of analytics. Two definitions of analytics were presented to the INFORMS members for evaluation. The first definition was based on analytics as a specific method of analysis and read as follows: "Analytics is the discipline of applying analytical methods ranging from descriptive to predictive to prescriptive modeling to drive better decision making". The second definition defined analytics in terms of a process as follows: "Analytics is a process of transforming data into actions through analysis and insights in the context of organizational decision making". INFORMS members evaluated the method-based definition more positively than the process-based definition.

Gartner [7] defines advanced analytics as, "the analysis of all kinds of data using sophisticated quantitative methods (for example, statistics, descriptive and predictive data mining, simulation

and optimization) to produce insights that traditional approaches to Business Intelligence — such as query and reporting — are unlikely to discover".

The preceding definition of advanced analytics is not clear on the demarcation between advanced analytics and analytics in general. A different dimension is needed. In a SAS white paper published in 2009 a compelling argument was presented for defining analytics and data along a data and analytics continuum [1]. The continuum starts with data which are transformed to information and finally to intelligence. Each analytical component is associated with a specific position on the continuum. The first analytical component is standard reports, followed by ad hoc reporting, query drill down and alerts. Alerts are followed by statistical analysis, forecasting, predictive modeling and finally optimization. A possible demarcation associated with advanced analytics would be to include statistical analysis, forecasting, predictive modeling and optimization while excluding standard and ad hoc reporting, query drill down and alerts. Based on the SAS data and analytics continuum model as a method for demarcation it is clear that all operations research methods, statistical analysis and data mining techniques can be included as part of advanced analytics.

Winston [44] defines operations research as "a scientific approach to decision making that seeks to best design and operate a system, usually under conditions requiring the allocation of scarce resources". He defines a scientific approach to decision making as "the use of one or more mathematical models". It is safe to say that the mathematical models referred to by Winston can be classified as descriptive, predictive and prescriptive models as proposed by Ragsdale [39].

Ragsdale defines three categories of mathematical models based on the structure of the problem that needs to be solved. These categories are: descriptive models, predictive models, and prescriptive models. Within each of these categories, Ragsdale gives examples of operations research or management science techniques that are typically used to solve problems in the specific category. It is important to note that the list of techniques given by Ragsdale is not complete as it represents the main topics in his textbook. It does give a good indication of the type of techniques that are grouped within each category.

Ragsdale's definitions of the different categories of mathematical models are more precise than those provided by Liberatore and Luo [28]. He defines the categories as follows [39]:

- Descriptive mathematical models are used where the functional relationship between the dependent and independent variables are well defined. There is uncertainty relating to the values of one or more of the independent variables. Descriptive models are used to describe the output of the system based on the preceding functional relationship and associated uncertainty. According to Ragsdale, the operations research methodologies that are used in descriptive mathematical models are simulation, queuing theory, PERT analysis, and inventory models.

- Predictive mathematical models are used to determine the value of a dependent variable based on the values of the independent variables. Where the functional relationship between the variables is unknown, predictive mathematical models are used to estimate it. Operations research methods that are associated with this category are regression analysis, time series analysis, and discriminant analysis.

- Prescriptive models are used to determine the values of the independent variables that will result in the best possible value of the dependent variable. The functional relationships between the dependent variable and the independent variables are well-defined and the independent variables are under the control of the decision maker. Operations research methods include linear programming, networks, integer programming, CPM, goal programming, EOQ, and non-linear programming.

Based on the preceding definitions of operations research the Gartner definition can be expanded to read as follows:

> Advanced analytics is the analysis of all kinds of data using sophisticated quantitative methods to produce insights that traditional approaches to Business Intelligence — such as query, reporting, and alerts — are unlikely to discover. These advanced quantitative methods include:
>
> - Descriptive methods such as statistical analysis, descriptive data mining, and simulation,
> - predictive methods such as forecasting, discriminant analysis, and predictive data mining, and
> - prescriptive methods such as mathematical programming, combinatorial optimization, constraint programming, and stochastic optimization.

Even though the proposed definition may provide some clarity relating to the relationship between advanced analytics and operations research, it is not particularly business friendly. A more business orientated definition is required to explain advanced analytics to a business audience.

Liberatore and Luo [28] defined analytics as "a process of transforming data into actions through analysis and insights in the context of organizational decision making".

Combining this more general definition of analytics with the categories of methods proposed by Ragsdale a business friendly definition can be developed. Such a definition could read as follows:

> Advanced analytics consist of descriptive, predictive, and prescriptive modeling techniques that are used to transform data into actions within the context of organizational decision making. Descriptive analytics is a combination of techniques that are used to formulate a better understanding of the past. Predictive analytics attempts to determine the probability of some future event occurring. Prescriptive analytics refers to a portfolio of techniques that prescribes the best possible action that can be taken, given a particular set of alternatives.

1.2 Problem statement

Despite the high potential impact of advanced analytics on the performance of businesses around the world, its uptake and application in an integrated and strategically aligned manner has been limited.

This problem is more pronounced with specific reference to optimization. Liberatore [27] points out that optimization methods lag behind other analytical methods such as data visualization and predictive models in terms of the level of adoption in organizations. Despite this he is of the opinion that operations research practitioners are faced with tremendous opportunities related to their potential contribution to the analytics movement .

The Gartner Group confirms this viewpoint. According to Gartner [7] most of advanced analytics efforts are focused on predictive analysis which is regularly accompanied by components of descriptive analysis. They point out that the other techniques in the advanced analytics category such as optimization and simulation are becoming increasingly important.

Sashihara [40] motivates the importance of optimization in terms of its contribution to the success of a number of corporations and its ability to increase the competitiveness of companies. He links these successes directly to the impact of optimization on decision makers' ability to make

optimal decisions in situations characterized by high volume and complex decision making processes. He argues that from this it would seem logical that optimization would be the first tool that executives would reach for when they are working towards achieving a competitive advantage. This is not the case and instead, Sashihara ranks optimization as a "non-thought" more than an afterthought at the point when executives consider different approaches to achieving competitive advantage.

Davenport [18] emphasizes the importance of competing on analytics with specific reference to its potential impact on business processes which, according to him, is one of the last potential sources of competitive differentiation. Despite an increasing trend in terms of embracing analytics, few organizations can be regarded as proficient users of analytics.

A survey conducted by Bloomberg Businessweek Research Services in April and May 2011 found that, of the 900 respondents, 97 percent claimed to be using "some kind of business analytics". Of these only 25 percent believed that their use of business analytics was effective when measured against its ability to help them make better decisions [2].

According to a survey conducted by MIT Sloan Management Review in collaboration with the IBM Institute for Business Value, 37 percent of the respondents claimed to be using business analytics to create a competitive advantage within their markets or industries. The researchers classified respondents in terms of their level of analytical sophistication. The different categories are aspirational users of analytics, experienced users of analytics, and transformed users of analytics. Aspirational users are basic users of analytics and made up around 32 percent of respondents. Experienced users are considered to be moderate users of analytics and they made up around 45 percent of the total number of respondents. The transformed users made up 24 percent of respondents and they are regarded as strong and sophisticated users of analytics [23]. The transformed users are yet again the minority confirming that the effective application and integration of advanced analytics in companies is the exception rather than the rule.

This research suggests that part of the problem of limited application and integration lies in an overall inability of companies to develop and implement an effective advanced analytics strategy.

1.3 Scope and objectives

The primary objective of this research is to establish an approach for the development of an advanced analytics strategy for a company. In general a strategy refers to a method or a plan that is developed to bring about a desired future such as the achievement of a goal or finding a solution to a problem [6]. The advanced analytics strategy is a plan to address the issues that restrict the application and integration of advanced analytics in businesses.

The achievement of the primary objective is based on the realization of a number of sub-objectives. The sub-objectives are to:

- Identify the main issues that may restrict the application and strategic integration of advanced analytics in businesses.
- Create a structure within which approaches to dealing with the issues can be presented and tested.
- Using these approaches and structure an initial advanced analytics strategy will be formulated.
- Develop an instrument that will allow for the measurement of the effectiveness of the initial strategy.

- Using this instrument test the effectiveness of the strategy with the key decision makers in the researched business.
- Analyze and interpret the feedback from the key decision makers and formulate the changes to the initial strategy that will improve its alignment with the decision makers' thinking on advanced analytics and increase the probability of its implementation.

The formulation of the improved strategy may point to a generic approach or process that can be used to formulate a strategy that more effectively addresses the issues that prevent the application and integration of advanced analytics in other businesses.

1.4 Relevance

The lack of application and strategic integration of advanced analytics may present a threat for its future development and application. Without a clear understanding and demonstration of the long-term value impact of advanced analytics, companies will be hesitant to use it. A study funded by the United Kingdom Operations Research Society aimed at identifying the factors that determine the "success and survival of internal OR Groups" in large corporations showed that operations research groups lacked business awareness which was interpreted as a lack of understanding of business needs and organizational culture [19].

Limited application of optimization, which is a key component of advanced analytics, can have direct implications for the continued development of operations research. Murphy [34] emphasizes the importance of the practical application of operations research in order for the science to maintain its relevance. "Operations research was founded in practice and practice gives meaning to operations research theory today".

The focus of this research will be on a company that has little previous exposure to advanced analytics and analytics in general. This represents an opportunity to gain a pure business perspective on advanced analytics and a better understanding on how to approach this segment of the analytics market which represents a clear growth opportunity for analytics vendors and practitioners.

The automation of key decision processes in businesses is becoming more and more of a reality as optimization and machine learning algorithms continue to grow in power and application [40]. This research may provide insight into the potential strategic application and integration of these algorithms as the enablers of an advanced analytics strategy.

Academic research that is focused on finding solutions to the restricted uptake of advanced analytics in businesses is limited. There are examples of studies that focus on the skills that are required to develop and implement analytics interventions [35, 36, 37, 20, 41, 29], but defining and dealing with potential restrictions on the implementation of analytics are not part of mainstream academic research.

In contrast a number of non-academic research studies, also referred to as "popular" or "gray" research, have been published in recent years. These studies usually have a corporate sponsor that is active in the analytics market as a software vendor, consulting firm, or both. The popular research into the application of analytics focuses mainly on what characteristics or traits are responsible for the successful deployment and application of analytics in specific corporations [18, 2].

One of the first of this kind of studies was conducted by Davenport [18]. Davenport and two other researchers, set out to determine the characteristics that define proficient users of analytics.

They studied 32 companies based on their current commitment to fact-based decision making. Out of the 32 companies they were able to identify 11 proficient users of analytics, defined by public commitment to the use of analytics as a strategic enabler of business strategy, multiple complex data and analysis initiatives under way, and analytical activity at enterprise level.

In their survey Bloomberg Businessweek Research Services [2] wanted to establish if there are certain behaviors that characterized an effective user of business analytics. They concluded that such behaviors do indeed exist and proceeded to describe the behaviors in the format of ten practical steps that will "make business analytics work better for companies of any size, in any industry and at any level of analytics sophistication".

More recent attempts to research the application of analytics are more focused on explicitly defining restrictions to its application and strategic integration. There is also a more concerted effort to make effective and practical recommendations. The Deloitte Analytics Advantage Survey is an example of such a research study. The survey was conducted between April and September 2012 and covered an extensive range of industries with representatives from 75 companies in North America, the United Kingdom and Asia responding to an on line survey. The results from the on line survey were strengthened further by extensive one-on-one interviews with senior executives [3].

The Deloitte survey focused on a range of issues related to the effective application of analytics. These included data access, data quality and data utilization, assessment and availability of analytics talent, assessment of IT infrastructure supporting analytics, and barriers to the widespread implementation of analytics. The survey also investigated the organizational structure and funding implications of an analytics strategy [3].

In general, popular research into the application of advanced analytics tends to lack objectivity due to corporate sponsorship, defy practical implementation due the generality and non-specificity of its recommendations, be limited in its attempt to objectively test the acceptability of its recommendations, and focus on respondents that are involved with or have been exposed to analytics projects.

This research will strengthen the current body of work that is focused on the restricted application of advanced analytics by offering an academic viewpoint that is free of potential corporate bias, specific and detailed in its recommendations, and based on testing its recommendations with the senior business decision makers in an organization.

1.5 Limitations

To gain access to companies that are willing to allow the required level of investigation needed for the proposed research is challenging. The depth of analysis required to formulate a meaningful initial strategy is time intensive and is based on the input from senior resources with serious time constraints. Against this background the following potential limitations were identified:

- The required depth of analysis may be restricted due to limitations on access to sensitive internal company data. This may compromise the quality of analysis and forecasts.
- The potential impact on management time may be a limitation. The willingness of the organization to participate in the study may be compromised if excessive time commitments are required.
- The research is focused on the perspective of senior business decision makers on advanced analytics. This represents a relatively small number of individuals with busy schedules.

The small number of potential respondents may lead to difficulties relating to the pre-testing of any planned questionnaire with the aim of determining its validity. The time constraints will restrict this research to only one research cycle when the research method requires multiple cycles.

Most limitations can be addressed by providing value to the management team throughout the research process. The results of the various analyses will be shared with the senior team or representative of the senior team at regular intervals.

1.6 Assumptions

The research is based on the following assumptions:

- The feedback of the senior decision makers in the business will be independent.
- The senior decision makers have a working knowledge of finance and value management.
- The senior decision makers have some understanding of information technology and information technology related solutions.
- The feedback from the decision makers is truthful and represents their unbiased view.

Due to the seniority of the decision makers and the complexity and size of their business there is a high probability that most, if not all, of the assumptions would be met.

1.7 Overview

In Chapter 2 the research methodology that will support the development and testing of an advanced analytics strategy over multiple cycles will be defined. In Chapter 3 the various approaches to dealing with restrictive issues will be identified based on a survey of analytics and business literature. Chapter 4 will focus on the development of the initial strategy and an instrument aimed at evaluating the effectiveness of the initial strategy. In Chapter 5 the results of the strategy evaluation are presented, discussed and recommendations are made for the improvement of the strategy under review. In Chapter 6 key conclusions are presented. These include the value of the research process, insights gained from the research and potential future research topics.

CHAPTER 2

Research methodology

Contents

2.1 Introduction

The development of a robust advanced analytics strategy will be a challenging undertaking especially in the absence of well described examples or published research on the subject. What this means is that the research methodology that will be used must allow for the development and assessment of a potential strategy over multiple research cycles with each cycle generating the knowledge and insight needed to further develop and refine the strategy. Murphy [37] suggests action research as a useful alternative to the other more commonly used research methodologies. The development of a realistic initial strategy within the context of the researched business is time intensive and the research will have to be restricted to one company and one cycle when the typical action research process requires multiple cycles. The action research process is described in detail in the next section as it forms a key component of the proposed research methodology.

2.2 Research approach

James, Slater and Bucknam [22] define action research as "a type of research that creates and measures changes in a cyclical manner with the intention of overall positive growth throughout the process". They stress the collaborative nature of the research as well as its objective of not

only studying a problem but also creating and testing a particular solution during the research process.

In general the action research process starts with a problem definition, gathering more information on the problem, identifying and implementing specific actions, and monitoring the impact of the actions. These steps are repeated to form the action research process.

The action research process is determined by the action research model that is employed. Koshy, Koshy, and Waterman [25] identify three different action research models. In the first model, proposed by Kemmis and McTaggart, the action research process starts with planning specific change. After implementing the specific change the researcher observes the consequences of the change. After reflecting on these consequences the researcher will adapt the plan, act, observe and reflect, adapt, act, observe and reflect and so on. Koshy et al. note that this process does not always present itself in such a neat spiral and is often times "much more fluid".

The second model, proposed by Elliot, shares much of the Kemmis and McTaggart model. According to Koshy *et al.*[25], the Elliot model starts with the identification of a generic idea followed by fact finding, planning and the first action step. The impact of the action step is evaluated, the plan is amended and the second action step is implemented. The cycle continues with evaluation of the impact associated with the new action step.

The third model, proposed by O'Leary, formulates action research as a cyclic process that converges to a better situation understanding and improved action implementation after each cycle. Each cycle alternates between action and critical reflection as the main components of an evaluative process. From the O'Leary model's perspective action research is an experimental learning approach to change where data, methods and interpretation are refined based on the insight developed during the previous cycle. The O'Leary action research cycle consists of four steps namely, observing, reflecting, planning and acting [25].

James *et al.* [22] use an adapted O'Leary model with only three steps in a particular cycle. These steps are discovery, measurable action, and reflection as shown in Figure 2.1. The research methodology employed by this research is based on a three step O'Leary model.

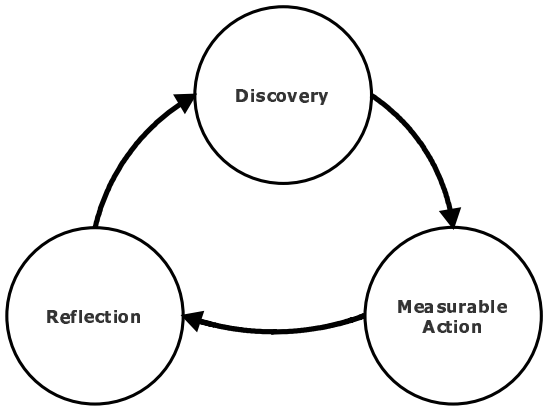

Figure 2.1: Three step action research process

During the discovery step the researcher investigates what others have done when faced with the problem situation that the researcher is aiming to improve. Sources can range from published, recognized academic papers to a wide range of community resources. The focus is on finding new ideas that will support potential improvements. The researcher starts formulating ideas that will have an impact on the next step which is, taking measurable action [22].

In the measurable action step, the researcher takes specific steps to improve the situation under investigation. At the same time the researcher must have identified and implemented research methods that can effectively measure the impact of the action steps. For any impact to be measurable the situation after the action must be compared to a baseline. The baseline must be identified and properly measured before any action is taken [22].

During the reflection step the researcher aims to determine what is working in the research process. There are two parts to the reflection step. In the first part the researcher sets out to make meaning of what has been discovered and determine what the next action should be. In the second part the researcher turns to the literature on the particular problem and ties the external opinion to what he or she has discovered through applied action [22].

2.3 Research methodology

The research methodology that will be use in this research will consist of the following main steps and is depicted in Figure 2.2:

- Completing an extensive literature survey,
- Formulating an initial strategy,
- Developing an instrument for measuring the effectiveness of the strategy,
- Testing the effectiveness of the strategy,
- Analyzing the results, and
- Making improvements to the initial strategy based on the feedback and analysis.

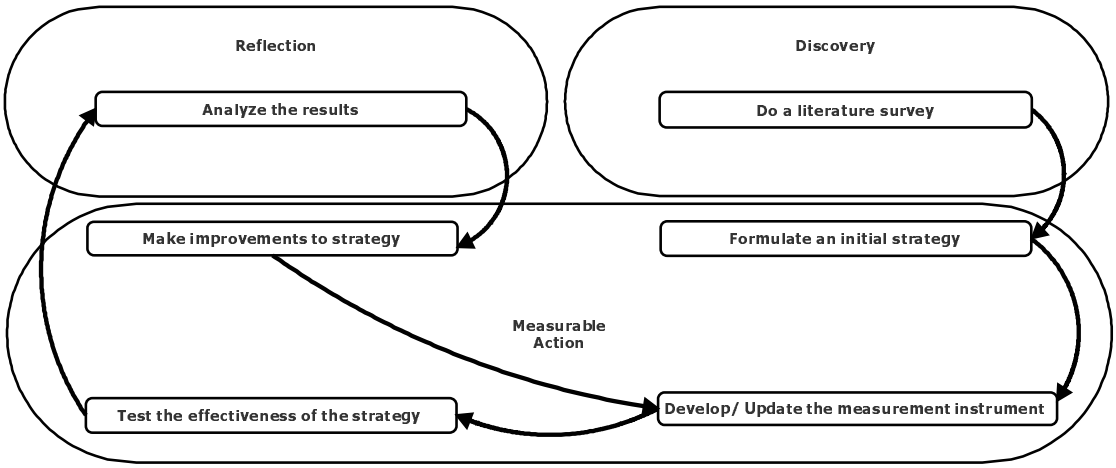

Figure 2.2: Research methodology

2.3.1 Literature survey

The research process will start with an extensive survey of practice orientated analytics literature. The aim of the literature survey is firstly to create a strategy framework and secondly to identify potential approaches to dealing with issues that restrict the application of advanced analytics. The findings from the literature survey will be used to formulate the detail in each

section of the strategy framework in order to create the first version of the advanced analytics strategy.

The practice orientated analytics literature includes academic resources such as scientific journals and published papers as well as non-academic resources such as web sites, trade magazines, white papers and non-academic and sponsored research projects. The analytics literature will be supplemented with literature on value management, financial management and behavioral finance.

2.3.2 Formulating an initial strategy

The first step in developing an advanced analytics strategy would be to define a framework that will facilitate a methodical approach to its testing and improvement over multiple research cycles. As mentioned in the preceding section, the general framework will be based on the findings from the literature survey.

The approaches proposed by various authors in dealing with the issues that restrict the application and strategic integration of advanced analytics, will be used to flesh out the framework and create the initial version of the advanced analytics strategy.

The strategy will also include a business case that will be developed within the context of value management and decision optimization. In order to present a realistic application of decision optimization, concept decision optimization models will be developed.

2.3.3 Developing the instrument for measuring the effectiveness of the strategy

The central construct that will be tested is the effectiveness of the strategy in dealing with the issues that prevent the application and strategic integration of advanced analytics within the context of the respondents' business.

Each section in the strategy document will be accompanied by a set of questions that aim to determine the level at which the reader is convinced that the presented approach will be effective. To allow for enumeration the level at which the reader is convinced will be captured using a four item scale with associated numerical values.

The respondent will be required to choose an option on the scale and to provide an explanation for each choice. The item scale will therefore be followed up with the simple question "Why?" and enough space for a handwritten response. The response to the "Why?" question represents the qualitative part of the questions. It will force the respondent to think about the choices made in the first part of the question. It will also give the respondent the opportunity to air opinions and make suggestions.

2.3.4 Evaluating the strategy

The instrument will be distributed to a senior team of decision makers in the business for which the advanced analytics strategy will be developed. The decision makers will include the group managing director, the group financial director, the divisional operations director, the company secretary, two non-executive directors and a representative of the largest investor in the organization. These are typically the decision makers that would need to be convinced before the implementation of an advanced analytics strategy would be approved. The instrument will

be presented to the respondents in one-on-one meetings after which they will be allowed to complete the questions on their own time.

Respondents will be encouraged to make notes on the strategy document in addition to the motivation that they supply in support of their rating of the effectiveness of the particular section. The data will be further augmented with information that will be gathered during the debriefing sessions with each respondent.

2.3.5 Analyzing the results

The quantitative analysis will start with analyzing the validity of the measurement instrument. The quantitative feedback will also be used to calculate the correlation of a question or group of questions' score with the total score across all questions. In addition, the total score obtained across all respondents will be expressed as a percentage of the total potential score for a particular question. These two measurements will be used in combination to prioritize sections in the initial strategy that may require improvement and additional emphasis.

Measuring instrument validity

Direct assessment of instrument validity would require the measurement of construct validity, content validity and concurrent validity [16]. The instrument would achieve construct validity if the questions are able to measure the effectiveness of the proposed strategy in addressing the issues that prevent the application and strategic integration of advanced analytics, it would achieve content validity if the issues that were identified are representative of the domain of all factors that prevent application and strategic integration of advanced analytics, and the instrument would achieve concurrent validity if the relationship between strategy effectiveness and the level at which a respondent is convinced that a proposed approach would work within the context of his or her business is strong.

Churchill [16] proposes that the validity of an instrument may be assessed in an indirect manner by measuring the instrument's reliability. This is true since a lack of reliability is negative evidence of the validity of the instrument. The extent of an instrument's reliability is determined by it not being influenced by transient factors. Reliability is therefore a measure of consistency but does not take systematic error (the same type of error for all questions, usually caused by an inaccurate measurement system or device) into account. The result of this is that reliability is a necessary but not sufficient measure of validity. The mere presence of reliability does not mean that the instrument is valid. Reliability is more easily measured and remains to be the most frequently investigated property of an instrument's validity.

The measurement instrument will be based on the domain sampling model. This model holds that the purpose of a measurement is to estimate the total score that would be obtained if all possible questions related to a particular domain could be used. Since this would be a practical impossibility, inadequate sampling of the domain of relevant questions can represent a major source of measurement error. Reliability is therefore determined by the extent to which relevant questions are included in the measurement instrument. Relevant questions will be those that relate to the construct that are being measured and is confirmed by responses that are highly inter-correlated. This level of inter-correlation is measured by the average correlation among the questions in the instrument. The average correlation is known as Cronbach's alpha and is calculated as

$$\alpha = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_t^2}\right),$$

where k is the number of questions in the scale (questionnaire), σ_i^2 is the variance of scores on question i across all subjects, and σ_t^2 is the variance of total scores across respondents where the total score for each respondent represents the sum of the individual item scores [16].

If alpha is low it can be improved by removing questions from the scale. These questions can be identified by calculating alpha without a particular question and determining if the exclusion leads to a higher alpha. It is important to exclude questions whose inclusion has a significant negative impact on alpha.

Generally an alpha value greater than 0.7 is regarded as good, greater than 0.6 but smaller than 0.7 as acceptable, greater than 0.5 but smaller than 0.6 as poor, and smaller than 0.5 as unacceptable [4].

Ideally this process of instrument refinement should be based on a sample of respondents before it is used on a broader scale. The limited number of respondents that will partake in this research as well as their seniority of position within the researched company will make this a practical impossibility.

Correlation with total score

The calculation of a specific question's correlation with the total score is based on the assumption that the total score of each respondent serves as a proxy for the true level at which a respondent is convinced that all the issues related to the restricted application and integration of advanced analytics have been effectively addressed in the strategy. Churchill [16] points out that there are a number of different methods that can be used to relate a particular question to a total score. He argues that the most conceptually appealing method is to relate question scores with total scores by calculating the correlation coefficient between the two. Questions are then ranked based on their correlation coefficients and those questions with a score near zero are deemed suspect and may be eliminated.

Measuring the level of effectiveness

Effectiveness is the degree to which objectives are achieved [5]. Dealing with the issues that restrict the application and strategic integration of advanced analytics is the primary objective of the strategy. The proposed measure of effectiveness is the degree at which the decision makers in the organization are convinced that the approach for dealing with a particular issue, as described in the strategy, will be effective within the context of their business. This can be measured in terms of the total score across all respondents expressed as a percentage of the maximum possible score that can be realized for a particular question or group of questions. Let ESS be the Effectiveness of the Strategy Section, then

$$ESS = \frac{\sum_{i\in B}\sum_{n=1}^{l} Q_{ni} \times 100}{k \times l \times m},$$

where B is the set of questions related to a particular section in the strategy, l is the number of respondents, Q_{ni} is the score given by the nth respondent to the ith question in the question set B, k is the number of questions in the question set B, and m is the maximum possible score that can be given to any question.

Visualizing the results

A scatter plot will be created that plots the effectiveness score on the x-axis and the correlation coefficient with the total score on the y-axis. The maximum and minimum axis values will be fixed based on the total range of the two variables across all questions. The point at which the x and y axis intersects will be determined by the medians of both variables.

2.3.6 Continuous improvement

The feedback and statistical analysis will direct the formulation of an improved advanced analytics strategy. The improved strategy will be tested in the next research cycle. This iterative process effectively establishes a platform for continuous improvement of the advanced analytics strategy.

2.3.7 Conclusion

The application of the proposed research methodology will lead to the achievement of the sub-objectives as outlined in Chapter 1. This in turn will lead to the realization of the primary objective namely the establishment of an approach for the development of an advanced analytics strategy for a company.

CHAPTER 3

Literature survey

Contents

3.1 Introduction

The objectives of this chapter are to:

- Identify the main issues that may restrict the application and strategic integration of advanced analytics in businesses, and
- Create a structure within which the approaches to dealing with these issues can be presented and tested.

3.2 Defining the structure

Based on the analytics literature the following main issues were identified that may restrict a business' ability to apply and strategically integrate advanced analytics:

- Defining the analytics-based competitive advantage,
- Defining and measuring the value impact of an analytics intervention,
- Defining and implementing the organizational changes that will support the development and implementation of an advanced analytics intervention, and
- Aspects that frustrate the successful development and implementation of a high impact analytics intervention.

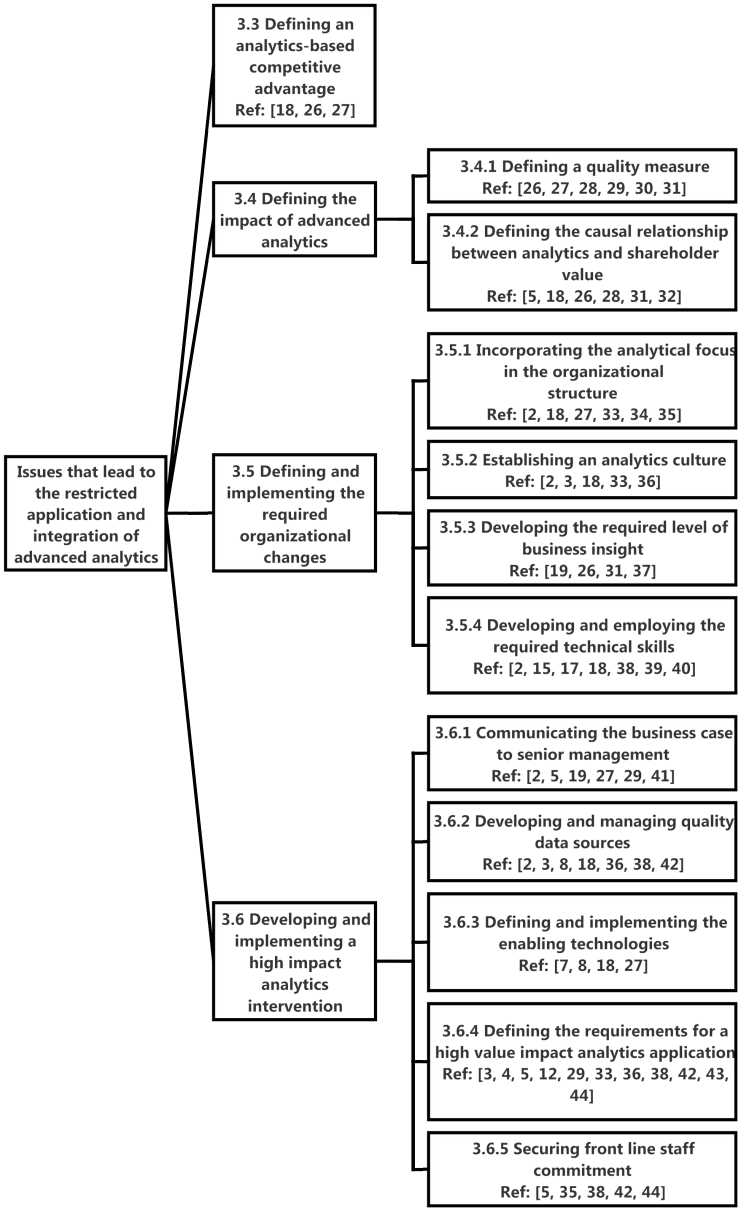

Figure 3.1: Structure development based on literature survey

As the literature survey expanded in scope, sub-structures emerged as clearly distinguishable sub-issues were identified. This process continued with regular revision of the structure until the final structure was defined. This final structure will be used in the remainder of this chapter to present the approaches as suggested by various authors to dealing with the restricted application and integration of advanced analytics.

It is important to note that the structure in this research was not proposed by a specific author. Instead it is the product of the iterative process described above. Figure 3.1 gives an outline of the structure and the literature sources on which it is based.

3.3 Defining an analytics-based competitive advantage

The first main issue relates to the difficulty that businesses have in defining an analytics-based competitive advantage. Some of the main points from the literature survey are as follows:

- Creating a sustainable competitive advantage is important for shareholder value creation.
- Companies find it difficult to define the competitive advantage that can be created through the application of advanced analytics.
- The ability to develop and implement advanced analytics applications that can optimize decision processes is in itself a competitive advantage.
- An analytics application presents a competitive advantage if it is valuable, rare, inimitable, and non-substitutable.

Creating a sustainable competitive advantage is important for shareholder value creation.
A sustainable competitive advantage is the basic source of shareholder value creation [24]. The following formula shows that if a company has a sustainable advantage that allows it to charge a price premium or produce at lower cost it will increase the return that it can generate on its invested capital. The formula also shows that a company's ability to maintain generate high returns on its capital is dependent on its ability to manage its tax liability and cost of capital. Let R be the return that the company can generate on its invested capital, C be the cumulative amount that the business has invested in its core operations also known as its invested capital (primarily property, plant and equipment, and working capital), N be its net operating profit less adjusted taxes, t the prevailing corporate tax rate, p_u be price per unit, k_u the cost per unit, and C_u the invested capital per unit then [24]

$$\begin{aligned} R &= \frac{N}{C} \\ &= \frac{(1-t)p_u - k_u}{C_u}. \end{aligned}$$

Companies find it difficult to define the competitive advantage that can be created through the application of advanced analytics.
Defining a long-term analytics-based competitive advantage is critical to the strategic integration of advanced analytics in an organization. It does seem as if few companies are able to define the competitive advantage that will be created through the application of analytics in their organizations. The Deloitte Analytics Advantage Survey found that only 18 percent of respondents were convinced that their companies' competitive advantage was reliant on its analytical capabilities.

A similar number of respondents (19 percent) believed that the use of analytics in their industry was generic and did not provide any real form of competitive advantage. The remainder of the respondents were not quite convinced about analytics' role in creating a competitive advantage. A total of 27 percent of the respondents believed that analytics provided some competitive advantage while 36 percent believed that analytics did not provide a competitive advantage at all [3].

The ability to develop and implement advanced analytics applications that can optimize decision processes is in itself a competitive advantage.
The ability to develop and implement advanced analytics applications in order to optimize key decision processes that contribute most to the capacity of the organization to create shareholder value may be regarded as a sustainable competitive advantage in itself. This statement will become apparent when it is assessed using a resource-based view of the firm.

The resource-based view of the firm holds that a company is "the construct of resources and competencies" [42]. A company's competitive advantage is therefore based on its ability to configure internal sources in such a way that it can differentiate itself from its competitors. The internal resource configuration must lead to the creation of distinctive capabilities that uses core competencies to leverage tangible and intangible resources within the organization to create a sustainable competitive advantage [42]. A company can realize a competitive advantage by creating an internal resource configuration that allows it to develop or employ core competencies that can optimize its key decision processes by leveraging its technology and data assets. If, in addition, these core competencies are grounded in analytics, it is clear that the company has created an analytics-based competitive advantage.

An analytics application presents a competitive advantage if it is valuable, rare, inimitable, and non-substitutable.
One way of increasing the probability of successfully creating a sustainable advantage is to focus on acquiring or developing resources that are valuable, rare, inimitable, and non-substitutable. Resources are valuable if they allow a company to realize improvements in efficiency and effectiveness if leveraged. Resources are rare if they are only held by the particular company or if they are difficult to source. Resources are inimitable if they cannot be replicated due to their uniqueness. Uniqueness of a resource is based on its history, causal ambiguity and social complexity. A resource is non-substitutable if the same outcome cannot be replicated from the application of a direct equivalent [42].

In summary, it is clear that a sustainable competitive advantage is a key component of a company's ability to create shareholder value. The ability to optimize key decision processes in a company does represent a competitive advantage and such an advantage can be created by developing advanced analytic capabilities in a company.

3.4 Defining the impact of advanced analytics

Defining the impact of advanced analytics relate to two distinct issues. The first issue relates to the definition of a quality measure with which the impact of analytics can be measured and the second to defining a causal relationship between an analytics intervention and the said quality measure.

3.4.1 Defining a quality measure

Defining a quality measure is the first step in effectively measuring the impact of advanced analytic initiatives. The main points from the literature related to the definition of a quality measure are as follows:

- An example of a quality business measure would be one that measures the ability of the business to increase shareholder value. A quality business measure is persistent and predictive.
- Analytics projects are usually assessed using capital budgeting statistics but these statistics are not good predictors of changes in shareholder value.
- An alternative to capital budgeting measures is intrinsic value which can be defined as the book value of a company's net assets plus the sum of its future economic profits discounted to the present.
- Intrinsic value is a more predictive indicator of shareholder value but is not perfect due to market mis pricing and the company's investor profile.
- The predictive ability of intrinsic value with regards to shareholder value can be strengthened through investor communications.

An example of a quality business measure would be one that measures the ability of the business to increase shareholder value. A quality business measure is persistent and predictive.
When determining whether a particular measure would be useful or not, Mauboussin [32] recommends asking two questions. The first question quite simply enquirers as to the objective of the effort that needs to be measured. Mauboussin suggests that in the case of a business, increasing shareholder value will qualify as a good objective. But increasing shareholder value is more than a good objective. According to Koller, Goedhart and Wessels [24] the most important measure for judging a company's performance is the amount of value that it creates for its shareholders. The second question relates to the activities that are required to realize the objective. The aim here is to identify statistics that "reliably reveal cause and effect" [32].

For a measure to show cause and effect in a reliable manner it must be persistent and predictive. A measure is persistent if it registers the same outcome for the same action taken during different time periods. A measure is predictive if there is a causal relationship between a particular action, the change in the measure and the change in the business objective [32].

Analytics projects are usually assessed using capital budgeting statistics but these statistics are not good predictors of changes in shareholder value.
In the analytics literature there seems to be a preference for measuring the impact of analytics projects using traditional capital budgeting statistics. Stubbs states that in general a project is assessed in terms of its financial return (in absolute terms), its rate of return, and the time it takes to realize a positive return. More specifically, a number of statistics are used in an attempt to quantify the tangible benefits associated with an analytics project. These measures are: the total cost of ownership, return on investment (ROI), payback period, net present value (NPV), and internal rate of return (IRR). The common tangible benefits associated with analytics projects that these statistics aim to quantify are profitability improvements, capital investment reductions, improved liquidity, lower levels of bad debt, and deferred investments. Stubbs argues that a clear understanding of the link between the tangible benefits and the suggested measure will allow for the translation of the relative complexity of analytics into specific outcomes that are well understood by the rest of the business [42].

INFORMS [8] also suggests the use of a number of statistics that are effective in guiding the allocation of scarce resources. These are: IRR which is described as the discounted rate used in capital budgeting to compare different investment opportunities, the NPV which is defined as the difference between the present values of investments and cash inflows, the future value (FV) which they describe as the upward adjusted value of some future event or item based on an adjustment rate such as inflation, and the payback period which is described as the time that it takes for all expenditure to be fully amortized.

The question is whether capital budgeting statistics may be regarded as quality measures of a company's ability to increase shareholder value as represented by an increase in the market value of its ordinary shares. Total cost of ownership, payback period and return on investment statistics do not take the opportunity cost of capital into consideration. Since value is only created if the return on assets is greater than the cost of capital, these statistics have no predictive ability related to market value and may be excluded from further consideration.

The more sophisticated statistics such as NPV and IRR incorporate the opportunity cost of capital. A positive NPV or an IRR that is higher than the opportunity cost of capital on a particular project is difficult to relate to a potential increase in market value as measured by an increase in share price.

An alternative to capital budgeting measures is intrinsic value which can be defined as the book value of a company's net assets plus the sum of its future economic profits discounted to the present.
An alternative to capital budgeting statistics may be found in a more sophisticated measure, namely the intrinsic value of the business. Buffett [17] regards the use of intrinsic value as the only logical approach when evaluating the attractiveness of investment opportunities. He defines intrinsic value as "the discounted value of cash that can be taken out of a business during its remaining life".

Ward and Price [43] define intrinsic value in terms of economic profit as follows: The calculated intrinsic value of a business at a particular point in time is equal to the book value of its net assets plus the sum of its expected annual economic profit discounted to the same point in time. Economic profit is the difference between the return on capital and the cost of capital.

Intrinsic value is a more predictive indicator of shareholder value but is not perfect due to market mis pricing and the company's investor profile.
The question now is whether intrinsic value is predictive of market value. The market value of a business is the sum of its debt and equity value. The equity value is determined by the price per ordinary share and the number of these shares in issue. Both intrinsic value and market value are expectations of the future and are therefore uncertain. Intrinsic value is an expectation of future economic profit, while market value is the result of major investor's expectations reflected in the price per share [43].

In an efficient market, market value will equal intrinsic value. In reality these measures do not always correlate [43]. Two potential contributors to a significant deviation of market value from intrinsic value are mis pricing by the market and the investor profile of the business [24].

The reality is that sizable individual deviations from fundamental values are exceptional and significant market deviations even more so. If such deviations do occur they tend to correct quickly, unless there are limits to arbitrage such as short-sell restrictions on shares or a small float of ordinary shares in the case of an individual company [24].

Where a company's investor profile includes informed investors, price deviation from intrinsic value may also be the result of the trading actions of those informed investors who are exploiting

over- or under-pricing of a share. The price movements stay within the bounds set by informed investors. These bounds do increase in line with increased uncertainty related to the future performance of a company. Price movements outside of the bounds are rare and usually occur when the number of noise traders in a company's investment profile outnumbers the informed investors [24].

The predictive ability of intrinsic value with regards to shareholder value can be strengthened through investor communications.
The impact of these deviations on the predictive ability of intrinsic value as it relates to market value can be further reduced through effective investor communications. To achieve alignment between intrinsic value and market value it is important to determine the gap between the two value measures, gain a better understanding of the investor base, and focus the communication effort on those investors that matter the most. Managers should focus their communication efforts on intrinsic value investors, since it is this group of investors that have the highest impact on the price of shares [24].

In summary, intrinsic value can be regarded as a quality measure of a business' value creating ability especially in situations where its significant ability to predict market value is strengthened through effective investor communications. It is arguably the best measure to use for measuring the impact of analytics initiatives on the shareholder value of a company.

3.4.2 Defining the causal relationship between analytics and shareholder value

The effective measurement of the potential impact of analytics initiatives on shareholder value requires that the link between these initiatives and a change in shareholder value be properly defined. Defining this causal relationship and the expected magnitude of the impact is based on the following main points:

- The process of identifying measures that clearly demonstrate the causal relationship between an analytics intervention and a change in shareholder value consists of three steps namely, defining a governing objective, assessing potential drivers, and defining the relationship between the drivers and activities of employees that require skill.
- A good governing objective would be the creation of economic profit since increased economic profit will result in an increase in intrinsic value which is a strong predictor of market value.
- Based on the formula for economic profit the key value drivers can be identified.
- The performance of key value drivers is determined by employee decisions which can be optimized through the application of advanced analytics.
- Decision optimization represents a sizable opportunity since decision processes that are mostly based on human experience and knowledge are sub-optimal due to biases and incorrect conventional wisdoms.

The process of identifying measures that clearly demonstrate the causal relationship between an analytics intervention and a change in shareholder value consists of three steps namely, defining a governing objective, assessing potential drivers, and defining the relationship between the drivers and activities of employees that require skill.
For analytics to be valued it is important to prove that its application will directly contribute to financial or operational improvement [3]. The potential causal relationship between the impact of

an analytics project and an increase in shareholder value is not defined in the analytics literature. Other disciplines may provide some direction. From the field of Behavioral Finance Mauboussin suggests a process for identifying a set of measures that will allow for the management of the cause-and-effect relationships in the organization that drives value [32]. This process consists of the following steps:

- Defining a governing objective,
- Assessing potential value drivers, and
- Defining the relationship with the actions of employees that requires skill.

A good governing objective would be the creation of economic profit since increased economic profit will result in an increase in intrinsic value which is a strong predictor of market value.
The process starts with defining a governing objective. A clear objective guides the allocation of scarce capital resources. Mauboussin suggests that the creation of economic profit is a logical governing objective for any company in a free market system [32].

Based on the formula for economic profit the key value drivers can be identified.
The next step involves the assessment of potential drivers based on their impact on the objective. The three most commonly cited financial drivers of company value are revenue, cost structure and capital investments [32].

An approach to the identification of key value drivers that is aligned with the governing objective of increasing economic profit will start with identifying the components of economic profit at the required level of detail. Koller *et al.* [24] define economic profit as the product of invested capital and the spread between the return on invested capital and the cost of capital. Let E be economic profit, C be the book value of the company's invested capital, R_p be the company's return on invested capital expressed as a percentage, and W_p be the weighted average cost of capital expressed as a percentage then

$$E = C \times (R_p - W_p).$$

From the economic profit formula above it is clear that annual economic profit can be increased by increasing R_p and reducing W_p.

Since,

$$R_p = \frac{N \times 100}{C},$$

where N is the company's net operating profit less adjusted taxes and C is its invested capital, R can be improved by reducing invested capital or increasing the operating profitability of the business. The key to improved levels of R lies in higher efficiencies related to asset utilization and cost structures. A commonly used measure of capital efficiency is the activity ratio. If we let A be the activity ratio, S be the total sales of the company, and C be the company's invested capital then [43]

$$A = \frac{S}{C}.$$

Let d be the total interest bearing debt of the company, e be the book value of the company's issued ordinary shares, C_t be the company's total capital in other words, the sum of its debt and equity, k_d be the cost of debt, t be the prevailing corporate tax rate, and k_e be the cost

of equity, then the final element of economic profit namely, W_p (the weighted average cost of capital expressed as a percentage) is calculated as

$$W_p = \frac{d}{C_t} k_d(1-t) + \frac{e}{C_t} k_e,$$

where $k_d(1-t)$ is the after tax cost of debt [24].

Operating profit, Activity and the weighted average cost of capital are the key business value drivers in any business since an improvement in any of these measures will result in an increased level of annual economic profit. Each of these value drivers can be managed based on the following principles:

- If all variable and fixed costs are grouped there are only four performance areas that can effectively be managed to improve operating profit. These are sales volume, sales price, fixed expenses and overheads, and the variable cost per unit. Operating profit is therefore managed by controlling selling prices, minimizing expenses and focusing on the more profitable products in the product portfolio [43].
- Activity is a measure of the amount of assets that are used to generate revenue and is therefore a direct measure of asset efficiency. Activity is managed by taking sales as a fixed amount and then focusing on the reduction of the asset base. The idea is to "sweat the assets" by increasing sales using the same level of assets or by realizing the same level of sales with a reduced asset base. Activity can be improved by managing the company's investment in fixed assets as well as its investment in working capital [43].
- Economic profit can also be increased through the downward management of the weighted average cost of capital. When the cost of capital is considered in absolute terms it is clear that it can be reduced by effectively reducing the absolute amount of capital that is used. Cost of capital can also be reduced by increasing leverage within prudent limits. Debt is generally half as expensive as equity. Finally, it is important to source cheaper debt and actively manage risk since a lower risk profile will reduce the required return on equity and debt [43].

The performance of key value drivers is determined by employee decisions which can be optimized through the application of advanced analytics.
The next step of Mauboussin's process focuses on identifying specific employee activities that support the achievement of the governing objective. The challenge here is to link the governing objective to financial drivers that are influenced by the activities of employees through the application of skill. This relationship must be persistent and predictive [32].

Based on the assumption that activities are preceded by decisions, this last step in Mauboussin's process establishes a cause-and-effect relationship with decision optimization. If a company can optimize the decision processes that determine price, volume, cost structure, the level and quality of fixed assets, the level of working capital, the level and cost of debt, and the current risk exposure of the business, the value drivers (operating profit, activity, and cost of capital) will improve dramatically leading to increases in annual economic profit and therefore the intrinsic value of the business which is a strong predictor of its market value.

Decision optimization represents a sizable opportunity since decision processes that are mostly based on human experience and knowledge are sub-optimal due to biases and incorrect conventional wisdoms.
In most businesses the impact of decision optimization can be substantial since the decision landscape, before optimization, is normally characterized by a wide range of decision biases and incorrect conventional wisdoms.

Sashihara [40] points to the complexity of decisions that need to be made when decision makers are focused on creating maximum value from the application of scarce and valuable assets. It is in these complex, high frequency, decision making environments that algorithmic based decision processes tend to outperform human decision making. The one major advantage that decision algorithms have over human decision makers is that they do not suffer from decision biases.

The inability to consistently evaluate available data or information to support a structured and high quality decision process is demonstrated by Makridakis, Wheelwright and Hyndman [31] who list twelve common decision biases when forecasting. They also propose ways of avoiding or at least reducing the impact of these biases.

Decision bias	**Reducing the impact**
The inconsistency bias refers to the situation when decision makers are unable to apply the same decision criteria in similar situations.	The decision process must be formalized through the use of decision rules.
Conservatism refers to the situation where the decision maker does not change his or her decision, or at most changes it slowly, even in light of new evidence or information relating to a particular situation.	Formalize procedures that forces action when certain changes do take place. It is obvious that the environment must then be monitored to identify the changes.
The situation where more recent events exert a higher level of influence than less recent events is referred to as the recency bias. In the case of recency bias the less recent events are downgraded or even ignored when formulating a decision.	To deal with recency it is important to remind decision makers that cycles do exist and that not all ups or downs are permanent. To determine a potential permanent shift, the decision maker will need to consider the fundamental factors that are driving the shift.
The availability bias refers to the reliance on information that is easily retrieved from memory often to the exclusion of other pertinent information.	Here it is important to present the complete picture to the decision maker. The information must be presented in such a way that all sides of a particular situation may be effectively considered.
Anchoring occurs when the decision maker is influenced by initial information that is given more weight during the forecasting process.	To deal with anchoring, the decision process needs to start with objective information, e.g., a statistical forecast. Any changes to the initial information must be based on proper reasoning.
When a decision maker believes that certain patterns are evident in the data or that a causal relationship exists between two variables, where indeed there are no such patterns or relationships, the decision maker is suffering from illusory correlations.	Patterns must be subjected to tests of statistical significance or at least attempt to model the relationship in terms of changes to try and confirm causality.
In some cases the decision maker will launch into a search for supportive evidence. Here, the decision maker will look for facts that support certain conclusions and in the process facts that may contradict the conclusions are ignored.	To deal with this it is important to purposefully introduce dis-confirming evidence or at least question the conclusions.

Decision bias	**Reducing the impact**
Regression effects refer to a belief that persistent increases (or decreases) are part of a trend, where in fact it points to a change in the variable under investigation.	Here, one would need to convince the decision maker that the deviations from the regression line are not random errors and will continue, indicating a permanent change.
When a decision maker believes that successes are attributable to his or her skills and failure is attributable to bad luck or someone else's error, learning from mistakes are inhibited.	Attribution of success and failure can only be addressed if people are encouraged to accept their mistakes and make those mistakes public so that they can learn to avoid similar mistakes in the future.
When a decision maker's preference for certain outcomes affects his or her forecasts of such outcomes the decision maker is suffering from wishful thinking or optimism.	To address this situation the forecasts have to be made by a disinterested third party or independently by more than one person.
The need to reduce anxiety combined with over optimism and illusory correlation will lead to an under-estimation of uncertainty.	By considering the impact of various future events, the decision maker can introduce objective uncertainty, especially when these potential events are determined by other people.
A decision maker introduces selective perception bias when solutions to problems are presented in terms of the decision maker's own background and experience.	In such a situation it would be helpful to ask people from different backgrounds to independently suggest solutions.

Table 3.1: Decision biases when forecasting [31]

Makridakis *et al.* [31] also list a number of conventional wisdoms related to decision making and the interpretation of information. They expose each of these conventional wisdoms by contradicting it to empirical findings.

Conventional wisdom	**Empirical findings**
The more information a decision maker has the more accurate his or her decision will be.	The amount of information on a particular issue does not determine the accuracy of decisions on this issue. It merely increases the confidence of the decision maker that the decision was made is correct.
Decision makers are able to effectively distinguish between relevant and irrelevant information.	Decision accuracy is reduced because of a decision maker's consideration of irrelevant information.
Decision makers believe that the more confident they are about their decisions, the more accurate these decisions are.	There is no link between the confidence of the decision maker and the accuracy of the decision.

Conventional wisdom	Empirical findings
Decision makers can decide rationally when it is time to quit.	In most cases this is not true. Humans have a deep urge to try and recoup previous inputs, even if these inputs should be regarded as sunk costs and should therefore not be considered at the point when the decision whether to continue or not is made.
Monetary rewards and punishments are enough to direct the behavior to a higher level of performance.	This has also been proven to be incorrect. Human beings need to be motivated by more, not just monetary rewards.
Humans are able to accurately determine their chances of success or failure.	Humans are over optimistic which leads to challenges and difficulties being downgraded or ignored in the assessment of potential success or failure.
Experience and expertise will always improve the accuracy of decisions.	The accuracy of repetitive, future orientated decisions is not enhanced by the expertise or experience of the decision maker.
Human preferences are stable and decision makers therefore know what they want.	Even slight changes can dramatically influence human preferences.

Table 3.2: Conventional wisdoms related to decision making and the interpretation of information [31]

Taking these biases and incorrect conventional wisdoms into consideration it would be fair to say that in many situations decision algorithms will lead to better decisions than what humans are capable of making. Decision algorithms can achieve a higher level of consistency and quality in decision making. The Deloitte Analytics Advantage Survey found that nearly half of the respondents were convinced that analytics is a key factor in improved decision making capabilities [3].

In summary, it is safe to say that there is a causal relationship between decision optimization and shareholder value creation and that the potential lack of decision quality in a company represents a tremendous opportunity if value driving decisions can be optimized.

3.5 Defining and implementing the required organizational changes

The strategic integration of advanced analytics may require a range of organizational changes which may include the incorporation of an analytical focus in the organizational structure, establishment of an analytics culture in the business, and the development or acquisition of the right level of business insight and technical skills.

3.5.1 Incorporating the analytical focus in the organizational structure

The realization of an analytics-based competitive advantage will in most organizations require changes in the organizational structure. The various approaches for incorporating an analytical

focus in an organization are discussed in the following section. The main points of the discussion are as follows:

- An organizational structure that effectively supports the implementation and continued use of analytics tends to follow one of the following formats: functionally aligned with a narrow focus, functionally aligned with a broad focus, and centralized analytics.
- Centralization is the most mature structure and tends to increase the application and acceptance of analytics in an organization.
- There are various forms of centralization including an internal consultancy, centers of excellence, and formal departments.
- The analytics department must be separate from the IT department in order to propel analytics to a position of power and respectability.
- An alternative to a formal analytics department is the analytics center of excellence.
- Analytics departments or centers of excellence must be headed up by an analytics team leader or department manager with strong people management skills, strategic thinking and planning skills, and practical modeling experience in multiple fields.
- In addition to the analytics department manager or team leader a senior management resource may be required.
- In practice the reporting line of the senior manager is not clearly defined. The most prevalent reporting line is to a business division or unit head followed by reporting to the CFO.
- The senior manger will focus on strategy development, making investment decisions related to analytics, forging data partnerships with value chain players, and engaging with analytics experts.

An organizational structure that effectively supports the implementation and continued use of analytics tends to follow one of the following formats: functionally aligned with a narrow focus, functionally aligned with a broad focus, and centralized analytics [42].
An analytics department that is functionally aligned with a narrow focus usually focuses on specific requirements such as fraud detection or the provision of market insight. The team size can vary from a small number of individuals to large teams that cover a wide range of roles and responsibilities. Although the team may have competencies that can be applied on a broader scale it is rare that a team will expand its focus area [42].

An analytics department that is functionally aligned but with a broad focus will report into a specific line of the business but, due to the successes achieved within the initial line of business, the team also provides analytic services to other business lines. In these situations, the analytics team is usually somewhat larger with a fairly comprehensive combination of roles and responsibilities [42].

Centralization is the most mature structure and tends to increase the application and acceptance of analytics in an organization.
Centralization of business analytics represents the most mature structure of a business analytics team. There is an ongoing debate regarding the centralization of analytics in a company. Survey statistics suggest that a centralized approach tend to increase the application and acceptability of analytics in an organization. This may be because a centralized approach leads to more

effective data acquisition and management and allows for centralized infrastructure and staff to be applied across more aspects of the business [3].

There are various forms of centralization including an internal consultancy, centers of excellence, and formal departments.
The nature of the centralization will vary from a consultancy where the analytics team cross charges business units for services delivered, center of excellence where the analytics team will report to a single owner as well as other business units in a matrix reporting structure, and finally a formally centralized structure where the team operates as a department in its own right [42].

In the formally centralized model the analytics team will leverage their competencies across all aspects of the business with their focus determined either by internal demand for analytical services or strategic imperative. The team in this situation tends to be a larger group with a comprehensive set of roles and responsibilities [42].

The analytics department must be separate from the IT department in order to propel analytics to a position of power and respectability.
The establishment of an analytics department separate from IT is a practical necessity for the effective application and integration of analytics. One third of respondents in the Deloitte Analytics Advantage Survey indicated that IT departments with shared analytics responsibilities were not able to propel analytics to a position of power and respectability within their organizations. The result was rudimentary or basic analytics infrastructure that had a severe limiting impact on the application and strategic integration of analytics [3].

An alternative to a formal analytics department is the analytics center of excellence.
If the organization is not ready for a formally centralized analytics department a good alternative would be to set up an analytic center of excellence [3]. Analytic centers of excellence are used by companies to catalyze analytics efforts. These centers work with business to rapidly develop and deploy analytics. The centers of excellence usually consist of data scientists, quantitative modelers, business specialists, and tool developers. They also include "translators". "Translators" are the individuals who have a solid knowledge of both business and analytics which means that they have the ability to effectively translate business requirements into analytics solutions [13].

Creating an analytic center of excellence holds the following advantages:

- The center of excellence boosts the company wide application of the scarce "translator" resource.
- Centers of excellence are also more effective at attracting analytical talent. At best they are hotbeds of innovation and learning as group members share ideas on how to construct robust data sets, build powerful models and translate the models into valuable business tools.

The goal of these analytic centers of excellence should be to build analytics capabilities across the organization to such a level that they can realize increasingly complicated and ambitious opportunities [13]

Analytics departments or centers of excellence must be headed up by an analytics team leader or department manager with strong people management skills, strategic thinking and planning skills, and practical modeling experience in multiple fields.
Heading up an analytics department or the analytics center of excellence is the analytics department manager or analytics team leader respectively. Stubbs [42] argues that a team is worth little without a leader that can provide clarity and direction.

Team leaders or department managers usually play a bigger role in management and mentoring than in modeling The analytics leader will be required to continuously grow the skill set offered by the team and maintain a high level of staff retention. In addition to a strong numerical background, the analytics leader must also be able to develop and manage a long range project plan for the implementation of the strategic plan that details how the business will achieve a competitive advantage based on analytics [42].

To do this effectively the analytics leader will have strong people management skills, strategic thinking and planning skills, and practical modeling experience in multiple fields. His or her background will span people management and strong practical exposure to analytics [42].

In addition to the analytics department manager or team leader a senior management resource may be required.
In addition to a team leader or department manager a senior management resource may be required. Davenport [2] states that if a company wants to make progress in terms of their use of analytics and fact-based decision making, it would need to employ an experienced analytical executive with business and analytics knowledge that can get the momentum going through trusted relationships and rapid, reliable delivery. McAffee and Brynjolfsson [33] argue that companies succeed with analytics not only because they have more or better data, these companies also have senior managers that can set clear goals, define what success looks like, and ask the right questions.

The realization of data related opportunities depend much on making the right investments in information infrastructure, being able to change mind sets and deliver effective front-line training programs. To keep the momentum going will be difficult for most organizations without additional senior management horsepower [14].

What is needed is a senior manager that can apply institutional knowledge, work through obstacles, make tough trade-offs, effectively resolve points of decision conflict, and in general signal that senior management is serious and committed to the analytics initiative [13].

In practice the reporting line for the senior manager is not clearly defined. The most prevalent reporting line is to a business division or unit head followed by reporting to the CFO.
The Deloitte Analytics Advantage Survey found that in practice a clearly defined approach relating to an analytics leadership structure does not exist. In nearly 23 percent of the cases analytics is headed by a business unit or division head. In organizations where senior management has shown some commitment to analytics, the senior management leader of analytics can be any of the following C-Level executives: Chief Executive Officer, Chief Financial Officer, Chief Information Officer, Chief Marketing Officer, and Chief Analytics Officer. These, combined with "Other C -suite executives", account for 56 percent of respondents.

Of some concern is the 20 percent of respondents who indicated that analytics was not any specific executive's responsibility. This points to the existence of an overall analytics leadership vacuum in many businesses [3].

The senior manger will focus on strategy development, making investment decisions related to analytics, forging data partnerships with value chain players, and engaging with analytics experts.
The development of a detailed analytics strategy will be one of the most important focus areas for a senior manager responsible for analytics. Without a clear strategy that details well structured initiatives and benchmarks for their success, analytics initiatives will under-deliver. In most companies, none of the senior managers are tasked with drafting such a strategy. If a senior manager has been tasked with drafting an analytics strategy, it is rare for the strategy to

be based on sufficient discussion or an effective alignment with strategic priorities. Capturing the benefits of analytics requires a clear plan with established priorities and a clearly defined path to the achievement of business results. Developing such a plan requires leadership and a dedicated effort [13].

In addition, the senior manager will also need to make critical investment decisions. The resource demands for an analytics project can be considerable. It is therefore important that the correct decisions are made in terms of buying core software or developing it in house [13].

Senior managers that are able to forge high level data partnerships with customers, suppliers or other players along the value chain can lock in access to valuable external data sources [13].

It is also important for the senior manager to engage a growing number of analytical experts. These are the individuals that will realize the value of data through the deployment of the predictive and optimization models that they build [13].

In summary, the establishment of a centralized analytics department is seen as the most effective and progressive approach to the incorporation of an analytics focus into a company's organizational structure. The practical implication would be that a company would need to appoint a senior manager, an analytics department manager, and a whole new analytics department in order to effectively implement an advanced analytics strategy.

3.5.2 Establishing an analytics culture

Culture is determined by the senior leadership of a company. Establishing an analytics culture is therefore a senior management responsibility. The main issues related to the establishment of an analytics culture in a company are as follows:

- A lack of senior management support is a serious barrier to the application and strategic integration of analytics in business.
- Establishing an analytics culture requires commitment at senior management level based on trust and a clear understanding of the strategic and operational opportunities that can be realized through the application of analytics.
- Senior managers need to embrace the idea that data is a core part of their business.

A lack of senior management support is a serious barrier to the application and strategic integration of analytics in business.
Nearly 13 percent of the respondents in the Deloitte Analytics Advantage Survey indicated that the primary reason why the business is not using analytics in a strategically integrated manner is due to the lack of understanding and support of analytics by the senior management team. In turn, the lack of senior management support leads to an under investment in analytics skills and infrastructure [3].

Establishing an analytics culture in an organization requires commitment at senior management level based on trust and a clear understanding of the strategic and operational opportunities that can be realized through the application of advanced analytics.
The amount of management effort required to mobilize the human and capital resources across various functions in order to deliver decision optimization tools that will help front line managers to optimize key decisions, can be substantial. The management effort will be focused on getting a diverse group of managers to work together across IT, analytics, training and business line

boundaries. It should be obvious that the probability of failure would be high without senior management commitment and involvement [13].

One of the major concerns that senior managers have with analytics projects is that their line managers do not trust the model output and in most cases they find it difficult to use. Not trusting the model output is usually the result of a mismatch between the existing culture and capabilities of the organization and the emerging tactics that are utilized to successfully exploit the analytics opportunity [9].

Managers in organizations that are regarded to be effective users of analytics place a great deal of trust in the output from analytics initiatives. This trust translates into executive support for analytics which in turn results in the provision of proper resources to enable the talent and technology acquisition that is required for the ongoing use of analytics in the business [2].

Senior managers need to embrace the idea that data is a core part of their business. "In a data oriented culture, behaviors, practices, and beliefs are consistent with the principle that business decisions at every level are based on analysis and data" [23]. The leaders of organizations that have mastered the analytics competency expect decisions to be based on objective analysis. These leaders are also clear about the role analytics can play in the achievement of their long-term visions for their organizations [23].

Senior managers need to embrace the idea that data is a core part of their business and they need to know what is becoming feasible in terms of data-based decision making. It is only when that top perspective is properly in place that durable behavioral changes can be radiated throughout the organization [13].

In summary, the best way of establishing an analytics culture is to get commitment at senior management level. This commitment can be realized through the appointment of a senior manager responsible for analytics.

3.5.3 Developing the required level of business insight

The level of business insight demonstrated by the analytics department determines its relevance and potential impact. The main issues related to business insight are as follows:

- To achieve strategic integration will require the analytics team to demonstrate a significant level of business insight and understanding.
- Having an in-depth understanding of the business has a direct impact on the perceived and actual relevance of analytics.
- The level of business understanding and insight of an analytics department can be dramatically improved through the development or acquisition of valuation modeling skills.
- The valuation exercise forces the analyst to assess the business from an investor's perspective and gain a better understanding of how the market will value the potential impact of analytics on revenue growth, margin increases or improvements in capital efficiency.

To achieve strategic integration will require the analytics team to demonstrate a significant level of business insight and understanding.
Having in-depth knowledge of the business has a direct impact on the perceived and actual relevance of analytics. Fildes and Ranyard's [19] research found that a direct result of the lack of strategic and business insight is that few internal operations research groups were able to make a contribution to the realization of a sustainable competitive advantage despite senior management sponsorship and plentiful resources.

The level of business understanding and insight of an analytics department can be dramatically improved through the development or acquisition of valuation modeling skills.
An overview of the valuation process will clearly illustrate the preceding point. Most valuation practitioners prefer to value companies using the Discounted Cash Flow (DCF) model. The DCF model consists of the following steps [43]:

- First the analyst needs to estimate the future free cash flow of the company up to the point where the growth in free cash flow stabilizes.
- At this point the analyst would need to calculate the continuing value of the concern using a perpetuity-based formula.
- Next, the analyst need to estimate the weighted cost of capital based on the cost and the target contribution of debt and equity to total capital.
- The analyst then discounts the continuing value and the forecast cash flow streams using the weighted average cost of capital as a discount factor.
- The intrinsic value per share is now calculated by dividing the intrinsic value of ordinary shares by the number of shares in issue.

In order for an analyst to develop a meaningful estimate of the future free cash flow of the company he/she would need to analyze the historical value creating performance of the business, and forecast revenue growth, return on invested capital, and free cash flow. The analysis of the historical value creating performance of the company starts with analyzing its return on invested capital and revenue growth and then moves on to the assessment of the credit health of the business. The analyst must have a clear understanding of the drivers of return on invested capital. These include profitability as well as the efficiency of asset utilization and are measured using statistics such as operating profit and the activity ratio [24].

The analyst must also have a clear understanding of the implications of realizing returns that are lower than the cost of capital. A company destroys value when its returns are lower than the cost of its capital. If it continues to destroy value or fail to realize its full economic profit potential it will become less able to attract new capital in the form of loans or equity. The sources of capital will also become more expensive and it will be increasingly difficult for the company to afford the capital needed to exploit growth opportunities. In the end such a company will simply fade away, become a takeover target or succumb to asset stripping raids [43].

Revenue growth is an important determinant of cash flow. The analyst must be able to distinguish between sustainable sources of revenue growth such as organic growth and growth from acquisitions and divestitures, and non-sustainable sources such as growth realized from currency fluctuations [24]. It is important for the analyst to have a clear understanding of the interaction between revenue growth and return on invested capital. According to Ward and Price [43], businesses tend to focus on growth to the point where they display “a growth psychosis”. This is because of the general belief that there is only a positive relationship between growth and value creation. For any level of growth an increase in return on invested capital increases value. The opposite is not true. Where return on invested capital is greater than the cost of capital an increased growth rate will increase the value of the company. Where return on invested capital is less than the cost of capital an increased growth rate will increase the rate of value destruction. Where return on invested capital is equal to the cost of capital, the growth rate has no impact on the value of the company [24].

The assessment of the credit health of the business requires a clear understanding of the power and danger of leverage. In addition, the analyst needs to form an understanding of the relative

credit risk of the business by comparing the debt-to-equity ratio of the business to that of its peers [24].

The ability to develop a sensible forecast of the expected value creating performance of the business is a critical component of the analyst's skill set and requires strategic, operational, and financial knowledge and insight. The forecasts are based on a host of assumptions related to the future return that will be earned on invested capital and whether the company will be able to stay competitive [24].

The enumeration of the key value drivers and their impact on the intrinsic value per share, provide the critical link between decision optimization and shareholder wealth creation. The quality of this link is directly related to the skills and qualifications of the financial modeling analyst.

The valuation exercise forces the analyst to assess the business from an investor's perspective and gain a better understanding of how the market will value the potential impact of analytics on revenue growth, margin increases or improvements in capital efficiency.
Finally, for the senior management representative of analytics to act as the translator between business and analytics, a deep understanding of value management and valuation modeling will provide the business insight that is required. The senior management representative of analytics in the company will be able to immediately pitch his/her findings to the chief executive officer and the board, gaining credibility and starting to shape the conversation on the role of analytics in shareholder value creation [15]

In summary, an analytics department can achieve the required level of business insight by developing or employing valuation modeling and value management skills. The ability to view the business from an investor's perspective will result in analytics interventions that are aligned with the core objective of any for-profit-company namely, shareholder value creation.

3.5.4 Developing and employing the required technical skills

The technical skills that are employed depend much on the core focus of an analytics department. It is important that the skill set is fully aligned with the focus of the department. The main issues related to the employment of the correct technical skill set are as follows:

- Companies are prevented from capitalizing on analytics due to a lack of analytics talent.
- Companies find it difficult to move beyond analysis towards decision optimization due to a misalignment of skills employed vs. skills needed for optimization.
- A company that is focused on optimizing key decision processes must employ optimization skills.
- Software development skills are becoming increasingly important.

Companies are prevented from capitalizing on analytics due to a lack of analytics talent.
The Deloitte Analytics Advantage Survey found that nearly half of the respondents could not fully capitalize on analytics due to a lack of analytical talent. In some organizations the problem can be remedied through training since they have an adequate number of staff but lack the required analytical skill level. Only 22 percent of respondents had the right number and level of analytical skill employed in their companies [3].

Having the right analytics skills in the organization is critical for the successful deployment of analytics. Companies that are regarded as being effective in their use of analytics are characterized by the fact that they have the right analytical talent on board [2].

Companies therefore need to have a plan that will guide the assembling of a pool of talent of the right size and mix [11]. One potential solution is to form closer relationships with universities and attempt to influence the development of degree programs with majors in analytics [3].

Companies find it difficult to move beyond analysis towards decision optimization due to a misalignment of skills employed vs. skills needed for optimization.
Companies find it difficult to move beyond analysis onto decision optimization. This lack of progress is mainly caused by a misalignment between the analytical skill set required to realize decision optimization and the analytical skill set that has been proposed in the analytics literature. For example, Davenport [3] suggests that "organizations that want to do big data right need to consider three talent centric pursuits".

- Evolve hiring practice within analytics to focus more on data scientist hybrids.
- Hire talented people with an analytics and computer science background and integrate them with business teams.
- Influence universities to focus on the training of data scientists.

As part of a survey designed to assist INFORMS in the change management process relating to their proposed expansion into analytics, the issue of skill requirements was investigated. Based on the survey data, Liberatore and Luo [29] compared the skill requirements for analytics professionals focusing on descriptive and predictive analytical methods and operations researchers with their focus on prescriptive analytical methods. Their findings clearly indicated that the importance of decision optimization is ranked low for analytics professionals. Analytics professionals ranked decision analysis in fifth position and optimization ninth out of nine possible ranking positions.

A company that is focused on optimizing key decision processes must employ optimization skills.
When a company employs an analytics professional focused on descriptive and predictive analytics or a data scientist focused on statistics and computer science, these individuals will normally not have the skill set required to optimize decisions. A company that is intent on optimizing key decision processes must focus on employing optimization skills.

Ittmann [21] points out that throughout its history operations research has always focused on assisting decision makers in their ability to make decisions through the use of quantitative methods, tools and problem structuring. Operations research has always focused on improving the quality of decisions.

Levin [26] points out that the process of prescribing optimal decisions is indeed nothing new. Prescriptive analytics has always been the domain of management science, operations research, and industrial engineering.

With the focus on decision optimization it would therefore make sense to employ optimization specialists as part of the core advanced analytics team and expand this team to include predictive analytics skills when needed.

Software development skills are becoming increasingly important.
Advanced software development skills are becoming an increasingly important requirement for high impact analytics teams.

In 2007 Hew [20] predicted that the market for operations research will make a fundamental shift from directly advising clients to developing tools that clients can use on their own. He argued that the primary driver for this shift was the "commodification" of information processing which provided more general access to computing power required to build and deploy expert operations research software.

He predicted that operations research practitioners will continue to play the role of personal advisor, but the growth opportunities lie in aiding the development and implementation of decision support systems [20].

In summary, the focus of an analytics department determine the required technical skill set. If the analytics department is focused on optimizing key decisions then the technical skill set of the department must include optimization, software development, and data management and analysis skills.

3.6 Developing and implementing a high impact analytics intervention

There are a range of aspects that can frustrate the successful implementation of a high impact analytics intervention in a business. These include difficulty in communicating the business case to senior management, data challenges, technology challenges, and the challenge of securing front line staff commitment.

3.6.1 Communicating the business case to senior management

Effectively communicating the business case to the senior management in a company is the most important element of a successful advanced analytics strategy. The main aspects related to this communication effort are as follows:

- What needs to be communicated is the business impact, the technical detail about the model and its output, and evidence that the solution can be delivered.
- A financial model must be developed to describe the potential value impact of a particular analytics project.
- The technical aspects must be communicated to allow management to judge whether the proposed model will meet the needs of the project and where future resources would need to be directed.
- It is important to demonstrate that the proposed solutions are possible, mainly through reference to past successes.
- The impact of the business case will be higher if it speaks to a wider audience of decision makers.

What needs to be communicated is the business impact, the technical detail about the model and its output, and evidence that the solution can be delivered.
Effectively communicating the impact of a proposed analytics intervention to senior management will not only be dependent on what is communicated, but also how it is communicated. Both aspects require close attention in order to develop a quality communication strategy. In general, what needs to be communicated is the business impact, technical detail about the model and its output, and evidence that the solution can be delivered [42].

Sashihara [40] argues that an optimization initiative should address a compelling business case. It is possible to get senior management to move towards optimization as an effective solution by tying it to specific business challenges such as:

- Increased complexity and increased competition that leads to under-utilization of assets,
- Increasing time to market for new products, and
- A general decrease in the efficiency of decision making processes.

In the absence of this link the optimization initiative may not get any real financial or management commitment.

A business case forms a critical part of communicating the value of analytics in that it formulates the reasons to management for releasing the necessary funds [42].

A financial model must be developed to describe the potential value impact of a particular analytics project.
The model formalizes the argument that the return from implementing the initiative is greater than the required investment [42]. The financial model may take the form of a detailed valuation model. The focus of a valuation model is on the determination of the intrinsic value of the business and is of sufficient detail to allow for the identification and prioritizing of value creating opportunities at decision process level. The identification of value creating opportunities is based on a sensitivity analysis of the valuation model.

The technical aspects must be communicated to allow management to judge whether the proposed model will meet the needs of the project and where future resources would need to be directed.
The second aspect of an analytics initiative that needs to be communicated to senior management is the technical detail of the model. The challenge lies in communicating results stripped of mathematical complexities and irrelevancies while retaining the rigorous logic that is required to secure understanding [10]. According to INFORMS [8], findings based on the model will be communicated to an audience with varying levels of technical knowledge and expertise. It is important to be sensitive to these differences and to adapt the message to suite the audience. When communicating technical information to a non-technical audience the actual message must not be distorted in the effort to make it less technical. In this regard, the use of graphics can be quite useful. Graphics can simplify results and display patterns and trends more effectively than tables. In addition to communicating the results or findings, it is important to be clear about the assumptions and limitations of the model. The audience must have enough information to judge whether the model will meet the needs of the project and where future resources would need to be directed.

It is important to demonstrate that the proposed solutions are possible, mainly through reference to past successes.
Positive results must be communicated throughout the organization to build a positive perception of analytics [2]. Fildes and Ranyard [19] support this view. They argue that in order for management to understand an internal OR group's effectiveness, these groups must market their services with the aim of promoting their capabilities, stimulate demand, and publicize their successes.

The impact of the business case will be higher if it speaks to a wider audience of decision makers.
A structured approach to what needs to be communicated based on the audience is presented by Stubbs. Stubbs [42] argues that individuals tend to approach and interpret new information from one or more of four perspectives. These perspectives are the analytical perspective, the process

perspective, the personal perspective, and the strategic perspective. In order to communicate effectively to the widest possible business audience, it is important to gain an understanding of each perspective.

The analytical perspective relies on logic, rigor, and rationality. An individual with this perspective will be interested in knowing how the initiative will create economic value, deliver a new competency or improve overall performance [42].

Communicating with individuals who prefer this mode of conceptualization will require focus on how the initiative will work. Formal communication methods are preferred but the target audience must have an opportunity to, through dialog, critically evaluate the proposed initiative. They would be interested in the detail behind the outcomes such as the amount and types of value that are being created, numerical measures, how value is defined and how it will be measured, the types of models that will be use and the assumptions that underpin the models, any evidence that support the particular approach, and examples of organizations that have taken a similar approach [42].

Individuals with an analytical approach will prefer to see logical relationships and structure. To communicate in this way will require a formal presentation that addresses the tangible and intangible value that will be created, evidence that demonstrate the potential for success (proof of concept), an explanation of how the evidence was collected, the next steps required in order to start realizing value, and delivery time frames [42].

The process perspective focuses on what needs to be done. This often involves identifying the changes that need to be made to the current processes in order to realize the defined value. People with this perspective will therefore be interested in how things will need to change to support value creation. They tend to focus on quality, governance and process issues [42].

The focus of communication will be on how things will be done and this will be explained in a formal presentation. Individuals with a preference for the process perspective will be interested in the structure behind the execution and how risk will be managed. Some of the project aspects that need to be communicated are a description of the process that will be impacted on, how the changes will lead to improved governance, transparency and quality, the detailed sequence of steps that need to be taken to deliver the project, how the project will be managed, specific examples of expected efficiency improvements, measurement of time frames and outcomes and the impact of the changed process [42].

A presentation to individuals with this preference to communication will specify the tangible value that will be created, the current process and outcomes that are being achieved, the changes that will need to be made, whom the changes will impact, and a detailed explanation of how these changes will be implemented [42].

Individuals who prefer a more personal perspective will tend to focus on how the initiative will make people better off. These individuals prefer a less formalized means of communication and would be interested in talking things through to get to a common understanding and possibly contribute some ideas. They will mainly be interested in knowing who in the organization will be impacted and how the initiative will impact on their staff's interests and career development preferences. Other aspects of interest will include the impact on quality of working experiences, the potential emotional impact of changes, cross functional collaboration opportunities, career and personal development opportunities (for themselves and their staff), and their potential contribution to the initiative [42].

These individuals therefore tend to think about things in terms of people and relationships. A presentation to individuals that have a personal perspective of the initiative will focus on what

the initiative is trying to achieve, the tangible value that will be created, the business-level measures of tangible value that will be created, the people that will be involved in the initiative, an overview of how the departments will work together, an explanation of how the departments will extend their responsibilities, and an overview of how these extended responsibilities will help a particular department [42].

The strategic perspective focuses on the holistic impact of the project. This usually includes the competitive advantage that will be created and the innovations that the proposed project will deliver. For someone with a strategic perspective, being visionary, doing new things and seeing the big picture is important. These individuals therefore need to understand the strategic implication of the initiative first [42].

The main focus when communicating with these individuals should be on how the initiative will make the organization better. Communication methods are less structured and more collaborative in nature since these individuals will normally want to contribute ideas to make the initiative better [42].

In general they will be interested in how the initiative will improve the organization's level and nature of participation in the market. More specifically, they will be interested in understanding the current practice in the market related to the particular issue that is being addressed, diagrammatic descriptions of what is being proposed, the competencies that the initiative will develop, the competitive differentiation that will be created, how the initiative aligns with strategic imperatives, the sources of innovation that is being created, and how things will be different [42].

For these individuals it is important to think about the holistic view and the synthesis of concepts. To effectively communicate with this group it is useful to explain through a less formal context the tangible and intangible value that will be created, how the initiative align with strategic goals, a comparison against industry best practice, a conceptual view of how the initiative maps into the organization, and the new competencies and innovations being developed [42].

Stubbs [42] argues that everyone communicate differently and because of this effective communication does not occur naturally, but requires a plan. Successfully communicating the value of analytics will require careful consideration of the communication preferences of decision makers at an environmental as well as a personal level. A better understanding of the decision makers' roles and communication preferences will allow for the identification of factors that are likely to influence the formal and informal decision making processes in the company.

Within this framework it would be possible to tailor the communication of the value of analytics to a given audience, create holistic communications that are more likely to be accepted, and link key messages to personal motivations [42].

In summary, a potential framework for communicating a business case within the context of value management and decision optimization will include the following main sections:

- Assessment of the historical value creating ability of the business.
- Identification and prioritizing of value creating opportunities.
- Assessment of key underlying decision processes.
- The specification of high value impact analytics applications.
- Project team structure, main work streams and time frames.
- Quantification of the net value impact of the proposed interventions.

3.6.2 Developing and managing quality data sources

The amount of resources allocated to data management efforts is determined by the general approach to the implementation of analytics in a company. The main issues related to the development and management of quality data sources are as follows:

- The lack of data quality, integrity and consistency is one of the main barriers that prevents the effective adoption and use of analytics in organizations.
- Companies tend to focus most of their analytics effort on data acquisition, cleansing and integration. In many cases companies already have the data they need to make more effective decisions.
- There are two main approaches to data at the point when a business starts with analytics initiatives: These are the data centric approach and the application centric approach.
- The data centric approach usually leads to large scale allocation of resources to data integration efforts.
- The initial focus on the specific data needs of particular applications will allow for effective delivery of high impact solutions over the short to medium term but does not nullify the need for data integration over the medium to long term.

The lack of data quality, integrity and consistency is one of the main barriers that prevents the effective adoption and use of analytics in organizations.
Quality data is critical to optimization modeling and during the modeling process a significant portion of time and resources are allocated towards working with data. This is because data populates the logical structures of an optimization model and makes it relevant to the decision at hand. Data is therefore the life of optimization [1].

The Deloitte Analytics Advantage Survey defines good or excellent quality data as data that is integrated, accurate, and maintained in a central data warehouse. Only 34 percent of respondents were convinced that their companies' data are good or excellent. Another 31 percent described their data as "adequate" while four percent considered their data to be of "poor" quality meaning that it is difficult to use the data for substantial analysis. It is clear that many companies continue to struggle with data quality, data access and data analysis [3].

It is therefore important that the business create a data management strategy. Companies that are more successful in their application of analytics have put in place three important data management processes: general data governance rules and policies, defined data stewardship, and master data definitions [23].

Companies with a strong data foundation are able to capture, combine and use information from many sources. It also allows the company to disseminate information so that individuals throughout the business, at virtually every level, have access to it [2].

Companies tend to focus most of their analytical effort on data acquisition, cleansing and integration. In many cases companies already have the data they need to make more effective decisions.
Managers just don't seem to know how the information can be used in making key decisions. Starting with the problems they wish to solve or the opportunities that they would like to exploit, businesses must do a more comprehensive but focused search of the available information sources [9].

There are two main approaches to data at the point when a business starts with analytics initiatives: These are the data centric approach, and the application cen-

tric approach.
The data centric approach is the default approach in most analytics initiatives. With this approach the business will start gathering any data that they think might prove useful, or they simply work through their internal data with the hope of finding valuable insights. Breuer, Forina and Moulton [12] argue that analytics initiatives should not be "fishing expeditions". They recommend that companies focus first on the decision they would like to improve and then move onto the data and analysis that will help improve these decisions. This would be an application centric approach to data management.

The type of decisions that need improvement as well as the data and analysis that will realize such an improvement will influence other decisions relating to the analytics project. These are decisions relating to the structure of the data, acceptable levels of data accuracy and whether to purchase off the shelve data management software or develop proprietary systems [12].

The data centric approach to data management usually leads to large scale allocation of resources to data integration.
Generally businesses have access to large amounts of information, but the information is usually stored and managed horizontally, by business units, or vertically by function. In many cases there are critical data sources in legacy IT systems that are used in areas such as pricing, customer service, and supply chain management. Today, the situation is even more complex since there are large amounts of external data available [11].

To get meaningful use out of this information and turn it into a long-term asset for the business, usually requires a substantial investment in new data capabilities. A game plan for data integration may highlight the need for large scale reorganization of the business' data architecture over time. This may involve creating high quality centralized data from the tangled set of data repositories in the business and creating data governance standards that will allow the business to maintain data accuracy in a systematic manner [11].

The initial focus on the specific data needs of particular applications will allow for effective delivery of high impact solutions over the short to medium term but does not nullify the need for data integration over the medium to long term.
Biesdorf, Court and Willmott [11] admit that another approach would be to focus on the data needs of specific analytical opportunities. They argue that over a shorter time horizon, it might be useful for a business to outsource the integration problem to data specialists who can focus on a particular aspect of integration that will support the realization of a number of initial analytical opportunities.

The initial focus on the specific data needs of particular applications will not nullify the need for data integration at some point in the future. Businesses will eventually have to plan for data integration campaigns as the expanding set of valuable models and tools will require an increasing range of data sources. This range of data sources may include internal data from customers, transactions and operations, as well as external information from value chain partners, web sites and sensors embedded in physical objects [11].

In summary, there are two main approaches to data. These are the data centric approach which holds that data is the primary focus of analytics initiatives or the application centric approach which holds that data is an enabler of decision optimization applications. The approach to data management is again a function of the primary focus of the analytics department. If the focus is on the development and implementation of decision optimization applications the department will follow an application centric approach to data management.

3.6.3 Defining and implementing the enabling technologies

Choosing the right advanced analytics platform will have a direct impact on the ability of the company to realize its central analytics objective. The main issues related to the definition and implementation of an analytics platform are as follows:

- Few companies have a robust analytics platform that allow for data management, and descriptive, predictive and prescriptive analytic functionality.
- A logical starting point when deciding on an appropriate analytics platform would be to identify the technology gap that needs to be bridged between current and required systems.
- The next step would be to choose an analytics platform vendor. Vendors are assessed along the following dimensions: functionality, ability to execute, and completeness of vision.
- The assessment will determine if a vendor may be regarded as a leader, challenger, visionary, or niche player.
- When compiling a short list of vendors to evaluate it is recommended that a group of at least eight vendors are identified and that this group must include two or three leaders.

Few companies have a robust analytics platform that allow for data management, and descriptive, predictive and prescriptive analytic functionality.
Choosing the right technology platform for the implementation of an analytics initiative is integral to its successful deployment and application. Analytics is a data intensive process and requires sophisticated technology that allows the business to properly analyze the data and deploy solutions. Only seven percent of respondents in the Deloitte Analytics Advantage Survey had a robust analytics platform that included data management, and descriptive, predictive and prescriptive analytics functionality. The remainder suffer from an analytics platform deficiency that makes it difficult for these organizations to fully realize their analytics-based opportunities [3].

A logical starting point when deciding on an appropriate analytics platform would be to identify the technology gap that needs to be bridged between current and required systems.
Analytical assets are developed on an analytical platform. This analytical platform is the combination of tools that are used to create analytical assets and store and manage data [42]. Such a platform would for example include data management, data mining and optimization allowing for full integration using a single programming language [1].

A logical starting point when deciding on a particular analytics platform would be to assess the level of sophistication or maturity of the current analytics platform in the business, determine what the required level of sophistication and maturity is, and identifying the technology gap that needs to be bridged.

Stubbs [42] suggests a classification system for determining the maturity level of a company's analytics platform. First he distinguishes between strongly defined and weakly defined analytical processes. A strongly defined process is clearly defined, repeatable, can be automated, and leads to the creation of value. A weakly define process has no such structure. It relies on the ingenuity of the analyst to complete the task successfully.

Analytical platforms tend to vary in their maturity within the following broad categories: unstructured chaos, structured chaos, dominant team platform, dominant department platform, and dominant enterprise platform [42].

In the unstructured chaos stage of platform maturity, there is a wide variety of desktop-based tools in the business. Data often exists in tabular format on individual PCs and no data sharing takes place. Analytical processes are undefined and the individuals working with analytics are explicitly linked to the analytical competencies of the business. An analytical competency therefore only exists if a particular individual is linked to it through its operation and maintenance [42].

During the structured chaos phase there are common desktop-based tools that are used to perform analytics. Data exist in tabular format on network drives and some data sharing does occur. The analytics processes are weakly defined. Individuals are still explicitly linked to the business' analytical competencies, but these competencies are now applied across multiple projects [42].

In the dominant team platform phase analytics tools are server-based and are used by the analytics team to create competencies. Data exists in a team-level data mart and data sharing regularly occurs. Analytics processes are strongly or weakly defined within the team as appropriate. The analytics competencies of the business are now held at team level [42].

In the dominant department platform phase of analytics platform maturity, there exists a common departmental level platform that is server-based. Data is stored on a departmental-level data mart and cross-functional data sharing occurs on a regular basis. The analytical competencies are recognized at departmental level and applied across multiple projects [42].

In the dominant enterprise level phase analytics tools exist at enterprise level and are server-based. Data exists in departmental data marts and cross functional data sharing regularly occurs. Strongly and weakly defined analytical processes exist and are well understood. Analytical competencies are recognized at enterprise level and contribute to the competitive advantage of the organization [42].

The next step would be to choose an analytics platform vendor. Vendors are assessed along the following dimensions: Functionality, ability to execute, and completeness of vision.
The next step would be to choose an advanced analytics platform vendor whose products and services can effectively support the technology requirements imposed by the proposed level of platform maturity. Gartner [7] evaluates the functionality of leading providers of advanced analytics platforms using the following dimensions:

- Data access: Refers to all the functionality that allows extraction and integration of a wide range of data types and formats.
- Visualization and exploration or discovery - refers to the functionality that allows for visualization of basic relationships and trends to more advanced visualization that supports statistical analysis.
- Data filtering and manipulation: Refers to the functionality that allows for the manipulation of raw data sets to allow for more advanced statistical analysis.
- Advanced descriptive analytics: Refers to statistical methods aimed at identifying categories and relationships.
- Predictive analytics: Refers to a range of methods aimed at predicting the occurrence of some future event.
- Optimization: Refers to a range of solver and heuristic methods aimed at finding optimality subject to constraints.

- Simulation: Refers to a range of methods that allows for static as well as time and motion simulation models.
- Further advanced analytics: Refers to functionality that allows for the analysis of unstructured data types, financial modeling, econometrics, and signal processing and control.
- Analytical business use cases: Refers to a combination of functionalities aimed at modeling in specific functional areas such as marketing, sales, risk management, quality management and others.
- Delivery, integration and deployment: Refers to functionality that allows for effective use of different delivery platforms and integration with current business processes.
- Platform and project management: Refers to the range of functionality that allows for platform and model management.
- User experience: Refers to all functionality that supports ease of use.
- Performance and scalability: Refers to all functionality that determines platform efficiency.

In addition to functionality, a vendor is assessed in terms of its ability to execute as well as the completeness of its vision. To determine a vendor's ability to execute the vendor is assessed in terms of its ability to [7]:

- Offer a total solution,
- Maintain overall financial health,
- Invest in product development,
- Support the sales process through effective pre-sales support, pricing, and negotiation,
- Respond to past and future market changes,
- Develop and deliver high quality marketing programs,
- Develop and execute high quality customer service programs, and
- Realize its goals and meet its commitments.

A vendor's completeness of its vision is assessed in terms of its ability to:

- Effectively respond to customer needs,
- Develop and maintain a robust sales network,
- Keep the product and service offering relevant,
- Maintain a sound business proposition,
- Meet the needs of specific market segments and vertical markets,
- Align resources with innovation needs, and
- Align resources with geographical expansion priorities.

The assessment will determine if a vendor may be regarded as a leader, challenger, visionary, or niche player.
The strength of a vendor in its ability to execute and the completeness of its vision determine the quadrant into which it will be classified. These quadrants are [7]:

- Leaders: Leaders are strong in terms of their ability to deliver and have a well defined vision of their future direction. These vendors have the ability to influence the market in terms of growth and direction.
- Challengers: There are two types of challengers. Firstly, there are those that have been in the market for a long time and therefore have the ability to deliver on their promises. They may need to work on their future vision to keep up with market developments. Secondly, there are challengers whose product does offer a viable alternative for the majority of potential customers but they lack broader market influence.
- Visionaries: These are usually smaller vendors that are effectively keeping up with the trends that are shaping the market. As they mature and prove their ability to deliver, they may move into the leader quadrant.
- Niche players: There are two types of niche players. The first type can deliver what they offer but are struggling to make their vision compelling to the market or build a track record of continual innovation. The second type are vendors that are maturing in their specific domain but their product strength does not allow for their offering to be a default choice, even for their existing customers.

When compiling a short list of vendors to evaluate it is recommended that a group of at least eight vendors are identified and that this group must include two or three leaders.
When compiling a short list of vendors to evaluate, Gartner [7] suggests a total number of eight vendors that includes two or three leaders. The remaining positions can be filled with a combination of challengers and visionaries. The company should include visionaries if it is looking at providing a compelling capability that will offer a competitive advantage or a solution that will complement current solutions. Gartner [7] also suggests that current users of advanced analytic platforms should allow themselves six to nine months for evaluating alternatives before their current software licenses expire. Even when a user is satisfied with its current vendor it may want to consider the introduction of another platform to facilitate specific types of analysis.

Potential users of advanced analytic platforms should not necessarily default on market leaders. The evolution of this market will make it challenging for traditional vendors to keep up with the pace of innovation and newer entrants may be able to meet more specific requirements [7].

In summary, most companies will be faced with the decision to implement an advanced analytics platform at some stage of strategy implementation. The guidelines presented in this section will be invaluable when making this decision.

3.6.4 Defining the requirements for a high value impact analytics application

For an analytics application to be regarded a high value impact application it must meet the following requirements:

- It must be highly relevant in terms of business focus and impact,
- It must be integrated with current business processes,
- It must be transparent in terms of its methods and results,
- It must be easy to use, and
- It must preserve user autonomy.

Business relevance
Liberatore [27] points out that insights based on analyses have limited value unless it is translated into managerial actions such as improving operational decisions, redesigning or changing existing processes, and formulating or adjusting strategies.

Barton and Court [9] argue that performance improvements and competitive advantage are only delivered through the development and implementation of models that allow managers to predict and optimize outcomes. The most effective approach to modeling rarely starts with data. Instead it starts with identifying the business opportunity and determining how the model will improve performance. They point out that the implementation of analytics initiatives may fail simply because it is not in sync with the day-to-day processes and decision making norms of the business. This leads to a disconnect between the proposed approach and the way in which the business actually makes decisions. This is usually the case where the initiative does not provide a clear blueprint for realizing business goals. In short, the analytics solution lacks business relevance.

Breuer *et al.* [12] argue that in most cases where companies have failed to generate value from their analytics initiatives, they failed to give adequate attention to turning data-driven insights into effective action on the front line. They point out that having the right data and skills alone will not deliver the required value. Companies must ensure that the analysis and insights are generated and integrated into the daily decision making processes of managers and front line staff.

Even where a model is "strikingly rich" in its ability to generate insight, it does not mean anything unless it is understood and used by managers and front line employees. If the output of the model is too complicated it will not be used since it will most likely be overwhelming and mistrusted. To solve this issue the business needs tools that integrate data into the day to day processes and translate modeling outputs into real business actions [11].

Brown, Court and McGuire [13] suggest that companies shift their focus to specific applications as oppose to the more general concept of employing analytics. The successful implementation of a high value impact analytics application will allow managers to gain an understanding of how analytics can improve performance. The variety of analytics solutions will demonstrate how the use of analytics can vary dramatically by business and industry. The main challenge lies in getting managers and staff to use new tools purposefully and enthusiastically. Part of the solution lies in the development of "killer applications" that combine smart intuitive design and robust functionality. Unfortunately companies do not invest enough time and resources in the development of such applications.

Sashihara [40] argues that the best and quickest way to develop champions for an optimization project is to deliver applications that create dependency based on their usefulness. These are "must have tools" which allows the business to quickly get optimization into the hands of their front line employees.

Biesdorf *et al.* [11] point out that it is not difficult to find analytics and software vendors that have developed applications and algorithmic models that can potentially address a business' analytics problems. These applications focus on aspects such as pricing, inventory management, labor scheduling, and more. Biesdorf *et al.* [11] warn that these generic solutions generally lack the qualities of a "killer application" despite their potential savings in money and implementation effort. According to Biesdorf *et al.* [11] "killer applications" are purpose built to realize opportunities presented in a real and relevant business case that was developed for a particular business.

To ensure the business relevance of potential decision optimization applications it is of paramount importance that the analyst has an in-depth understanding of the current decision processes and decision making norms of the business.

Murphy [35] developed a procedure for process evaluation based on the thinking of Woolsey and Wagner. Woolsey places emphasis on the exploration and problem definition phases. He believes that full process participation is required to develop the appropriate level of familiarity that will allow the analyst to model the process and make recommendations. His view is that people who do not do the process do not know what is really going on. It is only when the analyst really knows the process that he or she will be able to identify the step in the process that may present an opportunity for improvement. The suggested procedure is therefore to do the process until the analyst understands it as well as those who do it for a living, observe where the problem lies and recommend a fix.

Before developing a model Wagner [35] assesses the following characteristics of the decision process:

- The key decisions that are being made,
- The determinants of decision complexity,
- The elements of decision complexity that can be included in the model,
- The elements of decision complexity that may be ignored,
- The factors that distinguishes a practical decision from an impractical one, and
- The way in which the output of the model will be applied.

By using the preceding assessment process, Wagner [35] effectively explores the relationship between the model and the real world.

Murphy's [35] procedure for process evaluation has the following steps:

- Develop an understanding of the situation,
- Generate and test possible solutions,
- Evaluate the quality of the chosen solution, and
- End the process or return to step two.

Sashihara [40] suggests the following process which supports the four step process suggested by Murphy. According to Sashihara [40] the development of decision rules by the analyst starts with an initial set of rules provided by the Subject Matter Experts (SMEs). Once the analyst fully understands the underlying rationale for these rules they can be incorporated into a prototype analytics application. Testing and experimenting with the prototype allows the SME to further refine the rule set, maybe adding rules that are applicable in exceptional situations. All along, it is important for the analyst to critically review the decision rules in terms of their intention, relevance and recency.

Integration

In addition to business relevance the analytics application must ideally be fully integrated into the business process that it aims to improve.

Advanced analytical and programming skills make it possible to embed analytics in business processes so that analytics-based actions can take place seamlessly or even automatically. Embedded algorithms can automate processes and optimize outcomes [23].

The deployment of a solution within a business process requires a clear understanding of the analytics solution as well as the business process. The analyst must clearly define the point in the process where the analytics solution will be triggered, what data will be passed to the analytics solution, and what information will be passed back to the business process. The actions that will be taken based on the information provided by the analytics solution must also be clearly defined [8].

Maiste [30] points out that the integration of multiple, complex systems is one of the most difficult steps in the solution implementation process. Without effective integration, the model is for all intents and purposes dormant and will not deliver any real impact.

Transparency
According to Sashihara [40] application transparency can be realized by avoiding black boxes, developing and testing prototypes, and effectively dealing with incorrect model output.

He describes black box optimization as a "big software solver that produces a mega solution in some mysterious way." Sashihara [40] argues that it is better to implement a series of transparent solutions as oppose to a black box optimizer. Even though users do not need to understand the detailed workings of a particular optimization model, they do need to understand the rationale behind the recommendations.

Early prototypes of a solution should exhibit a high degree of transparency. Users should be provided with a clear explanation as to why a particular recommendation is made as well as the decision rules on which the recommendation was based. The high level of transparency proposed during the development and testing of the prototype has two distinct advantages. Firstly, it builds trust and confidence. Secondly, the ability to view the basis for model output allows the users and the programmers to easily identify and adjust incorrect or missing data and rules [40].

In the case where the model may be producing incorrect output it is important to approach the situation in a structured and disciplined way. First, it is necessary to investigate the potential sources of the incorrect output which may include calculation errors, data errors, incorrect decision rules, and complicated system integration. Sashihara [40] warns that the analyst must always take into consideration the potential impact that the application's users can have on the correctness of its output. In the case where the system integration is complex, it is useful to first get the prototype to work well as a stand-alone solution before moving to integration.

To further increase the transparency of a particular model, it is important that it is properly verified and validated. During the verification step the analyst must ensure that the model was built the way it was designed. The validation step refers to ensuring that the model represents real life to a certain level of accuracy. If the analyst realizes that validation or verification cannot be achieved, other modeling alternatives will have to be considered [8].

Ease of Use
Analytical tools are notoriously difficult to use by non-experts. These tools seem to have been designed for analytics experts rather than people in the front lines of the business. The reality is that if managers do not find the models and tools engaging enough to promote their use throughout the business these new models will not permeate through the organization. [9].

The answer lies in embedding the complex analytics in easy to use front line tools. Managers need easy to understand ways of interacting with the Tera bytes of data and sophisticated modeling that is needed to optimize marketing efforts, risk management, and operational activities [9]. In other words, deliver analytics applications to decision makers in a format that they can understand and act upon [38].

Breuer *et al.* [12] suggest that when the business designs new tools it should try and keep the solution as simple as is needed to realize the planned improvement. Where the situation demands more complex models, these should be implemented with the utmost care. Where highly complex models and algorithms must be used the project stands the risk of not being implemented by front line staff and management due to an inability to understand the model output.

Brown *et al.* [13] point out that one way of increasing the rate of adoption of analytics in a business is to create tools with intuitive user interfaces that can be rapidly deployed with little training.

Preservation of User Autonomy
Levin [26] argues that the world of management is too complex and that an expectation of optimality is unrealistic. In most cases the best that can be achieved is better solutions. Prescriptive analytics must therefore be used to make a base case suggestion that managers will then use to inform their thinking. A manager can accept the suggestion or adjust it to take into consideration aspects of the decision situation that are not included in the model.

Levin's suggestion of user autonomy is supported by Biesdorf *et al* [11]. They state that models should be linked to easy to use decision support tools and the new decision processes must allow managers to apply their own judgment and experience to the output of the models.

In summary, successful analytics projects are based on a set of principles that will have a direct impact on their successful deployment and effective use. These principles are business relevance, integration, transparency, ease of use, and preservation of user autonomy.

3.6.5 Securing front line staff commitment

Front line staff commitment to the use of a decision optimization application is a critical element in the successful application and integration of advanced analytics in businesses. The main issues related to securing front line staff commitment are:

- Many companies fail in ensuring front line management commitment with the result that front line managers and operational employees do not use the new models.
- There are a number of requirements that must be met to ensure the level of front line staff commitment that is needed for successful deployment of new analytics applications.

Many companies fail in ensuring front line management commitment with the result that front line managers and operational employees do not use the new models.
Analytics solutions must be embedded in front line tools that are so easy to use and are so engaging that managers and front-line employees will be eager to use them on a daily basis. The required level of adoption is realized through effective training, on the job coaching, and metrics that clearly measure and define success. The amount of effort aimed at ensuring front line adoption is important. In most cases, ninety percent of a company's investment in an analytics project is directed at model development with only ten percent aimed at model adoption and usage. This should be more towards fifty percent allocation of resources to model adoption and usage [14].

Biesdorf *et al.* [11] argue that when it comes to ensuring management commitment, many companies fail already in their thinking and planning. The result is that front line managers and operational employees do not use the new models. Some analytics approaches can be automated and does therefore not require any major front line engagement. The majority of analytics applications will fail without strong front line management support.

There are a number of requirements that must be met to ensure the level of front line staff commitment that is needed for successful deployment of new analytics applications.
The requirements are addressing employee fears, developing and implementing quality training and incentive programs, and ensuring user involvement in application development.

Addressing employee fears
Sashihara [40] argues that the unrelenting introduction of new technology can cause increased levels of workplace stress, a fear of job losses, and a deterioration of self-worth.

These fears are even more prevalent when optimization technologies are introduced due to its clear impact on decision accuracy and quality. To allay these fears in the short-term, Sashihara [40] suggests that optimization be positioned as a "job aid" and over the long terms as a "career advancer".

It is important for employees to understand that optimization is just one more tool that can dramatically increase the quality of their decision making. Optimization informs human judgment, it does not replace it. By using optimization tools, employees can realize levels of performance that was previously not thought possible. Superior performance is in the end the only consideration that carries any weight, especially in an environment of increased volatility and tighter resource constraints [40].

Developing and implementing quality training and incentive programs
According to Breuer *et al.* [12], the new way of working, as proposed by a particular model, relies on the alignment of incentives with the new approach as well as intensive training and coaching of front line staff on the use and application of the model.

Biesdorf *et al.* [11] argues that too many businesses belief that 95 percent of their analytics investment should be in data and modeling with only five percent allocated to training. If businesses do not develop analytical skills and train front line managers, who generally do not have an analytical background, their investments in data and modeling will not deliver much value. Biesdorf *et al.* [11] argue that at least 50 percent of funding must be allocated to training.

The emphasis on statistical training for front line managers is somewhat questionable. Sashihara [40] argues that individuals who will be using analytics applications, do not necessarily have to understand the technical detail of the applications. They do need to know why, when and how to use the applications. This implies that everyone who will be interacting with the applications must have a clear understanding of the objectives of the applications as well as what constitutes effective performance. It is important that the right combination of incentives and negative consequences are in place to reinforce the intended behavior.

User involvement in application development
Sashihara [40] stresses the importance of collecting user feedback on a particular solution. He argues that users need to be shown what the analysts are doing from the point of problem identification up to the deployment of the final piece of software. Users should be updated in incremental steps and at each step the analysts must get extensive feedback from their future user base.

Owen, Vander Veen and Frost [38] argue that it is important to engage the key stakeholders in the process of development and implementation in order to secure joint ownership.

In summary, front line staff and management commitment requires training, incentive programs, effectively addressing employee fears and involving future users in the development of the decision optimization application.

3.7 Conclusion

The literature survey was an attempt to consolidate the thinking of a wide range of authors on the challenges faced by businesses when attempting to implement analytics initiatives. The main challenges faced by businesses are the difficulty in defining an analytics-based competitive advantage, difficulty in defining the value impact of an analytics initiative, an inability to make the required organizational changes and finally the difficulties associated with the definition and implementation of a high value impact analytics initiative. The literature survey provided an extensive range of potential approaches to address these challenges. These approaches represent the primary input from which an initial analytics strategy for the researched business will be formulated.

CHAPTER 4

Initial strategy formulation and testing

Contents

4.1 Introduction

Using the approaches to deal with the restricted application and integration of advanced analytics that was identified in Chapter 3, an initial advanced analytics strategy will be formulated. The advanced analytics strategy will represent these approaches within the context of the researched business. The next objective would be to develop an instrument that would allow for the measurement of the effectiveness of the initial strategy. The strategy is deemed effective if it convincingly deals with the issues that prevent the application and strategic integration of advanced analytics in a business. Using this instrument the effectiveness of the strategy will be tested with key decision makers in the researched business.

The instrument will be presented to the key decision makers in the form of a strategy evaluation document. This document will be a structured advanced analytics strategy that includes evaluation questions aimed at testing its effectiveness.

The development of the strategy evaluation document will involve the following steps:

- Formulating an advanced analytics strategy framework,
- Formulating the initial advanced analytics strategy,
- Develop questions aimed at testing the level of effectiveness of the strategy.

4.2 Advanced analytics strategy formulation: The first cycle strategy framework

The strategy can be divided into four main sections. The first section deals with strategy objectives and impact measurement. This section outlines the primary objectives of the strategy, it details the creation of an analytics-based competitive advantage, it defines how the impact of the strategy will be measured and based on the assumption that increasing shareholder value is a primary objective, this section presents the causal relationship between an analytics intervention and an increase in shareholder value. This part of the strategy document is based on the sections of the literature study shown in Figure 4.1.

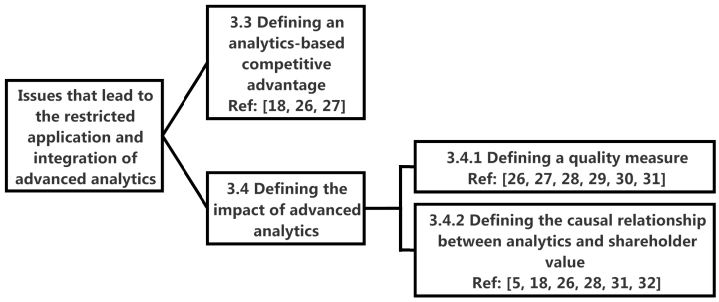

Figure 4.1: Sections in literature survey that relate to strategy objectives and impact measurement

The second section focuses on the capabilities that the company needs to develop that will allow it to optimize key decision processes. This section details the organizational changes that will be required to effectively incorporate the focus on analytics. It deals with the organizational structure that will support an effective analytics department, the need to establish an analytics culture in the organization, ensuring that the analytics department has the required level of business insight, and that the right technical skills are employed within the analytics department to support its focus on decision optimization. Finally, this section proposes an organizational structure, with an associated cost estimate, that will effectively support the implementation of all the recommendations made thus far. This part of the strategy is based on the sections in the literature study shown in Figure 4.2.

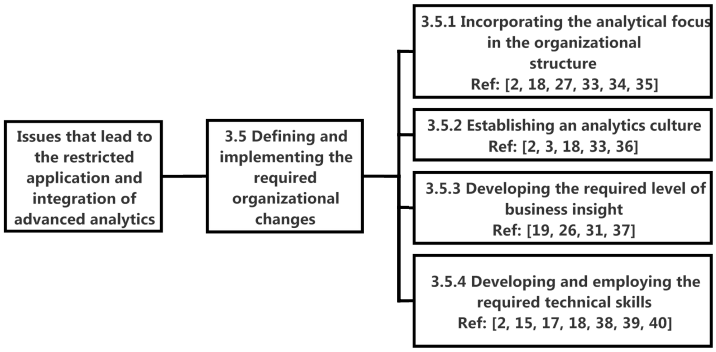

Figure 4.2: Sections in literature survey that relate to required capabilities

The third section of the strategy details general principles that directly influence the probability of successful implementation. These principles include aspects related to the development and

management of quality data sources, the selection and implementation of enabling technologies, the development and implementation of high value impact advanced analytics applications, and securing front line staff commitment to the application and use of the proposed analytics solutions. The sub-section on the development of high value impact analytics solutions discusses a number of characteristics of such applications that are regarded to be integral to successful deployment and use. These include a high level of business relevance, effective integration into current business processes, transparency related to the methods used and output generated by these applications, and the need to allow the user to override the output of the application. This part of the strategy is based on the sections in the literature study shown in Figure 4.3.

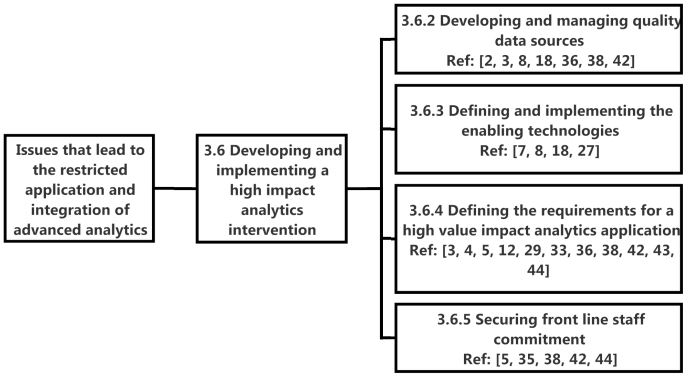

Figure 4.3: Sections in literature survey that relate to general design principles of successful analytics applications

The fourth and final section presented the business case for the implementation of a decision optimization project for one of the subsidiary companies of the holding company. The subsidiary company was acquired by the holding company in 2007. The subsidiary company specializes in the importation, distribution and marketing of industrial fasteners. The company has branches throughout South Africa. With close to 35,000 different stock items, the subsidiary company is one of the largest suppliers of steel fasteners in South Africa. The company supplies businesses in the mining-, construction-, manufacturing- and maritime-sectors.

The development of a business case within the context of value management and decision optimization required the development of a complete valuation model for the subsidiary company. The valuation model was used to assess the value creating ability of the company, identify value creating opportunities, and identify the key decision processes that underlie the value creating opportunities.

In order to present a realistic application of decision optimization, two concept decision optimization models were proposed. The first focused on price management while the second focused on inventory acquisition and inventory management.

The objectives of the pricing system was to introduce pricing discipline in the business, protect the gross profit margin, minimize customer churn as a result of incorrect pricing, and take advantage of pricing opportunities arising from the different demand and competitive profiles at branch level.

It incorporated a number of fundamental principles, namely that it must allow for branch level price determination, it must limit the risk of losing business due to sub-optimal pricing, and that it must not leave any money on the table.

The Price Management System consisted of three main sub-routines. These were:

- The Policy Price Sub-Routine which anchors the suggested price,
- The Pricing Logic Sub-Routine which selects a price level, and
- The Price Increment Sub-Routine which suggests a price increase.

The Policy Price Sub-Routine
The policy price sub-routine is used to calculate the minimum pricing bound for the customer and product combination. It uses the target gross profit margin, the product cost, and the list price of the product to calculate a Maximum Allowable Mark-up Price and a Maximum Allowable Discount Price. The next step was to calculate the value of gross profit that is associated with each. The price bound that is associated with the highest gross profit value becomes the Policy Price for this particular product. The aim is to anchor the suggested price to either product cost or list price, whichever results in the highest gross profit margin.

The Pricing Logic Sub-Routine
This sub-routine uses a set of logical statements or rules to move the price into a pre-set price range. The primary objective of this sub-routine is price level correction. If the most recent price is below the minimum allowable policy price, it corrects the price level by setting the suggested price equal to this minimum price level. If the price level is higher than the list price (an unlikely scenario) the system correct the price level by setting the suggested price equal to the list price. The list price represents the upper bound of the pricing range. If the customer is purchasing the product for the first time, the system currently suggests the list price. Finally, if the most recent price lies between the policy price and the list price, the algorithm branches to the Price Increment Sub-Routine which manages the progression of the suggested price from its current level to list price level.

The Price Increment Sub-Routine
The price increment sub-routine calculates a price increase based on the upward price progression of the most recent price when compared to the policy price. Using an exponential decay function, parameterized by a shape and a maximum price increment parameter, the relative distance from the most recent price is used to determine the increment applicable to the current price. The increments decrease in magnitude as the distance from the lower bound, represented by the policy price, increases. The rate at which the suggested price increments revert to zero is determined by the shape parameter. The maximum allowable price increment is determined by the second model parameter. The price progression continues until the list price is attained.

The second decision optimization model that was included in the initial strategy document was the inventory acquisition and management system. The aim of this system was to optimize supplier selection, order sizes and reorder points, and inventory distribution.

The system can be divided into two main systems namely the Branch-Level system and the Distribution Center-level or DC-level system. The output from the Branch-Level system feeds into the DC-level system.

The process starts with analyzing the demand profile for each product by branch. The output of this analysis is in the form of a daily demand probability distribution. The probability distributions are used as the primary input for simulating the demand and delivery pattern for the particular product and branch combination. The aim of the simulated optimization process is to find the order quantity and reorder point for a particular product and branch that will result in the lowest possible distribution and inventory holding cost while taking into consideration the uncertainty of customer demand.

The ordering patterns, which include the order quantity and the time interval between orders, are now aggregated across all the branches that are associated with a specific DC. The aggregated

ordering patterns constitute the demand profile for a particular product at DC level. The DC-level demand profiles are now used to simulate the ordering and delivery process associated with a combination of international and domestic suppliers. The order amount placed at a particular supplier is the result of the minimization of the acquisition cost, distribution cost (from port to DC or from supplier to DC) and the inventory holding cost (based on average inventory holding and the cost of capital) associated with that specific product.

For every planning cycle the Inventory Acquisition and Management System will generate an output file. The output of the system will be in a flat file format that contains the following data elements at distribution center level:

- Product order quantities by supplier and
- Product reorder points.

This flat file will be imported into a stock management database that will be accessed by the current transactional system. To effectively use the order quantity and reorder point recommendations we will develop a routine in the transactional system that will compare the current stock level at the DC with the reorder point and generate product orders of size equal to the optimal order quantity when the stock level is lower than the optimal reorder point.

At branch level the flat file will consist of:

- Product order quantities and
- Product reorder points for that specific branch.

When the inventory level reaches the optimal reorder point for that branch, the transactional system will generate an inventory order recommendation for ordering the optimal order quantity from the branch's associated DC.

Detailed specifications of the models can be found in the initial advanced analytics strategy document in Appendix A to this document.

Aspects related to the implementation of the proposed decision optimization applications included the identification of a potential project team, next steps and delivery time frames, and defining the net impact on shareholder value as reflected in the potential increase in the value of ordinary shares.

The business case is based on the section in the literature survey that relates to the effective communication of the business case to senior management and is shown in Figure 4.4.

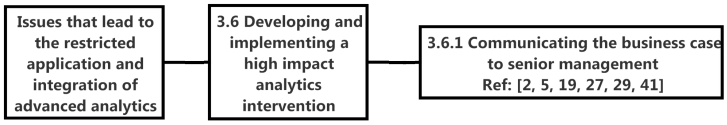

Figure 4.4: Section in literature survey that relate to the effective communication of the business case to senior management

The complete initial strategy framework is presented in Figure 4.5. The framework consists of four main sections namely, strategy objectives and impact measurement, development of capabilities needed to optimize key decision processes, principles and standards that directly influence the probability of successful implementation, and the business case for the implementation of a decision optimization project.

Figure 4.5: Advanced analytics strategy formulation: The first cycle strategy framework

The sequence of the strategy development process in the framework is slightly different from the structure that was developed in Chapter 3 and shown in Figure 3.1. The section related to the business case was moved to the end of the process since most of the preceding steps are more generic in nature while the business case is specific to the subsidiary company. This sequence improved the readability and logical flow of the initial strategy document.

4.3 Formulating the initial advanced analytics strategy

From the preceding section it should be clear that each section in the strategy framework relates to a specific issue or group of issues that restrict the application and strategic integration of

advanced analytics. In order to add the required level of detail to the strategy framework and create the first version of the advanced analytics strategy that effectively deals with all identified issues, a suggested approach for dealing with the particular issue would need to be identified. Table 4.1 presents the suggested approach for each section in the strategy framework.

Section in framework	**Suggested approach**
Defining an analytics-based competitive advantage	A sustainable competitive advantage is a key component of a company's ability to create shareholder value. The ability to optimize key decision processes in a company does represent a competitive advantage and such an advantage can be created by developing advanced analytic capabilities in a company.
Defining a quality measure	Intrinsic value can be regarded as a quality measure of a business' value creating ability especially in situations where its significant ability to predict market value is strengthened through effective investor communications. It is arguably the best measure to use for measuring the impact of analytics initiatives on the shareholder value of a company.
Defining the causal relationship between analytics and shareholder value	There is a causal relationship between decision optimization and shareholder value creation and the potential lack of decision quality in a company represents a tremendous opportunity if value driving decisions can be optimized.
Incorporating the analytical focus in the organizational structure	The establishment of a centralized analytics department is seen as the most effective and progressive approach to the incorporation of an analytics focus into a company's organizational structure. The practical implication would be that a company would need to appoint a senior manager, an analytics department manager, and a whole new analytics department to make an advanced analytics strategy work.
Establishing an analytics culture	The best way of establishing an analytics culture is to get commitment at senior management level. This commitment can be realized through the appointment of a senior manager responsible for analytics.
Developing the required level of business insight	An analytics department can achieve the required level of business insight by developing or employing valuation modeling and value management skills. The ability to view the business from an investors perspective will result in analytics interventions that are aligned with the core objective of any for profit company namely, shareholder value creation.
Developing and employing the required technical skills	The focus of an analytics department determine the required technical skill set. If the analytics department is focused on optimizing key decisions then the technical skill set of the department must include optimization, software development, and data management and analysis skills.

Section in framework	**Suggested approach**
Communicating the business case to senior management	A potential framework for communicating a business case within the context of value management and decision optimization will include the following main sections: • Assessment of the historical value creating ability of the business. • Identification and prioritizing of value creating opportunities. • Assessment of key underlying decision processes. • The specification of high value impact analytics applications. • Project team structure, main work streams and time frames. • Quantification of the net value impact of the proposed interventions.
Developing and managing quality data sources	There are two main approaches to data. These are the data centric approach which holds that data is the primary focus of analytics initiatives or the application centric approach which holds that data is an enabler of integrated analytics applications. The approach to data management is again a function of the primary focus of the analytics department. If the focus is on the development and implementation of decision optimization applications the department will follow an application centric approach to data management.
Defining and implementing the enabling technologies	Most companies will be faced with the decision to implement an advanced analytics platform at some stage of strategy implementation. There are well developed guidelines that will be invaluable when making this decision.
Defining the requirements for a high value impact advanced analytics application	Successful analytics applications are based on a set of principles that will have a direct impact on their successful deployment and effective use. These principles are business relevance, integration, transparency, ease of use, and preservation of user autonomy.
Securing front line staff commitment	Front line staff and management commitment requires training, incentive programs, effectively addressing employee fears and involving future users in the development of the decision optimization application.

Table 4.1: Approaches to dealing with the issues that restrict the application and integration of advanced analytics

4.4 Developing the questionnaire

The construct that will be tested is the effectiveness of the initial strategy in dealing with the issues that restrict application and integration within the context of the researched business.

Each section in the strategy document is accompanied by a set of questions that aim to determine the level at which the reader is convinced that the suggested approach would be effective within the context of his or her business. The reader can indicate the level at which he or she is convinced by selecting an option on a four item rating scale. Each item on the rating scale is associated with a numerical value to allow for enumeration as shown in Table 4.2:

Rating scale option	Numerical value
Not convinced	1
Not sure	2
Somewhat convinced	3
Convinced	4

Table 4.2: Enumeration of rating scale

For example, the literature suggests that a sustainable competitive advantage is a key component of a company's ability to create shareholder value. The ability to optimize key decision processes in a company does represent a competitive advantage and such an advantage can be created by developing advanced analytic capabilities in a company.

To test whether this approach would be effective within the context of the respondents' business the following questions were asked:

Question 2

Are you convinced that the ability to optimize decision processes represents a competitive advantage?

Why?

Question 3
Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow your company to optimize key decision processes?

Why?

The respondent will be required to provide an explanation for each answer when answering the follow up question "Why?" with enough space provided for a detailed handwritten response.

Table 4.3 contains the complete set of questions and the specific section of the initial advanced analytics strategy that it relates to.

Section	**Question Number**	**Question**
Strategy objective	1	How convinced are you that you should continue reading this strategy?
Defining an analytics-based competitive advantage	2	Are you convinced that the ability to optimize decision processes represents a competitive advantage?
	3	Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?
Defining a quality measure	4	How convinced are you that intrinsic value should be used to measure the impact of advanced analytics initiatives?
	5	How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?
Defining the causal relationship between analytics and shareholder value	6	How convinced are you that decision optimization will lead to an increase in shareholder value?
	7	How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?
Incorporating the analytical focus in the organizational structure	8	How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?
	9	How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?
	16	Are you convinced that the newly created senior management role should report directly to the Group Managing Director?
	17	Are you convinced that the IT Manager and the Analytics Department Manager should both report to the newly created senior position?
	18	Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?
	19	Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?
Establishing an analytics culture	10	How convinced are that establishing an analytics culture in the company will be important for the successful application of advanced analytics?
	11	How convinced are you that the most effective way of establishing such a culture could be through the appointment of a senior manager who must drive the analytics agenda?

Section	Question Number	Question
Developing the required level of business insight	12	Are you convinced that the analytics department must have business insight to effectively deliver value to the company?
	13	Are you convinced that the best way to gain this insight is to employ or develop value management skills?
Developing and employing the required technical skills	14	Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?
Communicating the business case to senior management	34	How convinced are you that the preceding section accurately accurately represents the historical value creating ability of the Subsidiary Company?
	35	How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?
	36	How convinced are you that the Subsidiary Companys value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?
	37	How convinced are you that the current price management decision process is sub-optimal?
	38	How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?
	39	How convinced are you that the current inventory acquisition and management decision process is suboptimal?
	40	How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?
	41	How convinced are you that the Price Management System has been thoroughly considered?
	42	How convinced are you that the Inventory Acquisition and Management System has been thoroughly considered?
	43	Are you convinced that the proposed project team will be able to deliver on the project?
	44	Are you convinced that these are indeed the next steps to get the project going?
	45	How convinced are you that the delivery time frames are realistic?
	46	Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?

Section	Question Number	Question
Developing and managing quality data sources	20	How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?
Defining and implementing the enabling technologies	15	Are you convinced that the company will have to invest in an analytics platform?
Defining the requirements for a high value impact analytics application	22	Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?
	23	Are you convinced that an in-depth understanding of the current and proposed decision processes is vitally important when developing analytics applications that are business relevant?
	24	Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?
	25	How convinced are that the advanced analytics application must be integrated with current business processes?
	26	How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?
	27	Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?
	28	Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?
Securing front line staff commitment	30	Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?
	31	Are you convinced that at least 50% of project resources should be allocated to ensuring front line staff commitment?
	32	How convinced are you that specific incentive should be put in place to support commitment?
	33	Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?

Table 4.3: Questions by strategy section

4.5 Conclusion

At this point a complete advanced analytics strategy had been developed based the approaches of a number of different authors to dealing with the issues that restrict the application and

integration of advanced analytics. To test the effectiveness of the strategy a questionnaire was developed and integrated with the initial strategy. In the next chapter the initial strategy will be tested and the results analyzed.

CHAPTER 5

Results and discussion

Contents

5.1 Introduction

In this chapter the feedback from the key decision makers was analyzed, interpreted and used as input to formulate the changes to the initial strategy in order to improve its alignment with the decision makers' thinking on advanced analytics and increase the probability of its implementation.

Strategy evaluation documents were distributed to a senior team of decision makers in the company which included the group managing director, the group financial director, the divisional operations director, the company secretary, two non-executive directors and a representative of the largest investor in the organization. Completed surveys were received from all but one non-executive director. This response rate is high taking into consideration the intensity of the evaluation. Most respondents reported a survey completion time of more than three hours.

The qualitative feedback was strengthened with additional information gathered during debriefing sessions with the group financial director and the group managing director. In addition, any notes that were made on the strategy documents by the respondents were recorded.

In preparation for the next research cycle the validity of the current research instrument (strategy evaluation document) was also assessed.

5.2 Analyzing the validity of the measurement instrument

The validity of the instrument was assessed by measuring its liability using Conbrach's alpha. The alpha for all questions, excluding the first and last questions which are not related to any particular section of the strategy, was calculated at 0.67. An alpha value of between 0.6 and 0.7 is regarded as acceptable [4].

The question now is whether the alpha coefficient of this instrument can be improved by removing some questions. The removal of questions 21 and 29 will result in an improvement in alpha of 0.07 and 0.05 respectively. These two questions may be removed without any real loss of information. After their removal Cronbarch's alpha increased to 0.78 which is regarded as good.

The remaining set of questions may all be regarded as relevant to the main construct of the measurement instrument. This in turn means that the quality of the results and analysis will also have improved through the removal of the two non-discriminatory questions.

5.3 Interpretation of quantitative results

The results from the quantitative analysis were plotted on a scatter diagram (Figure 5.1) that is divided into four quadrants based on the medians of the correlation coefficient with the total score and an effectiveness measure as defined in chapter two.

The correlation with the total score is a measure of the internal consistency of a strategy section. This is an indication of the degree at which the questions related to the section are indeed measuring the central construct which is the effectiveness of the strategy in dealing with the issues that restrict the application and strategic integration of advanced analytics within the context of the researched company.

The allocation of a particular strategy section to a quadrant points to improvements, refinements or emphasis of strategy sections within the strategy document as follows:

- The first quadrant contains issues that are important and the section in the document that explains the approach in dealing with the issue is effective. These sections can be further refined, but no major improvements are required.
- The second quadrant contains all issues that are important but where the respondents have not been convinced that the proposed approach effectively deals with the issues. These

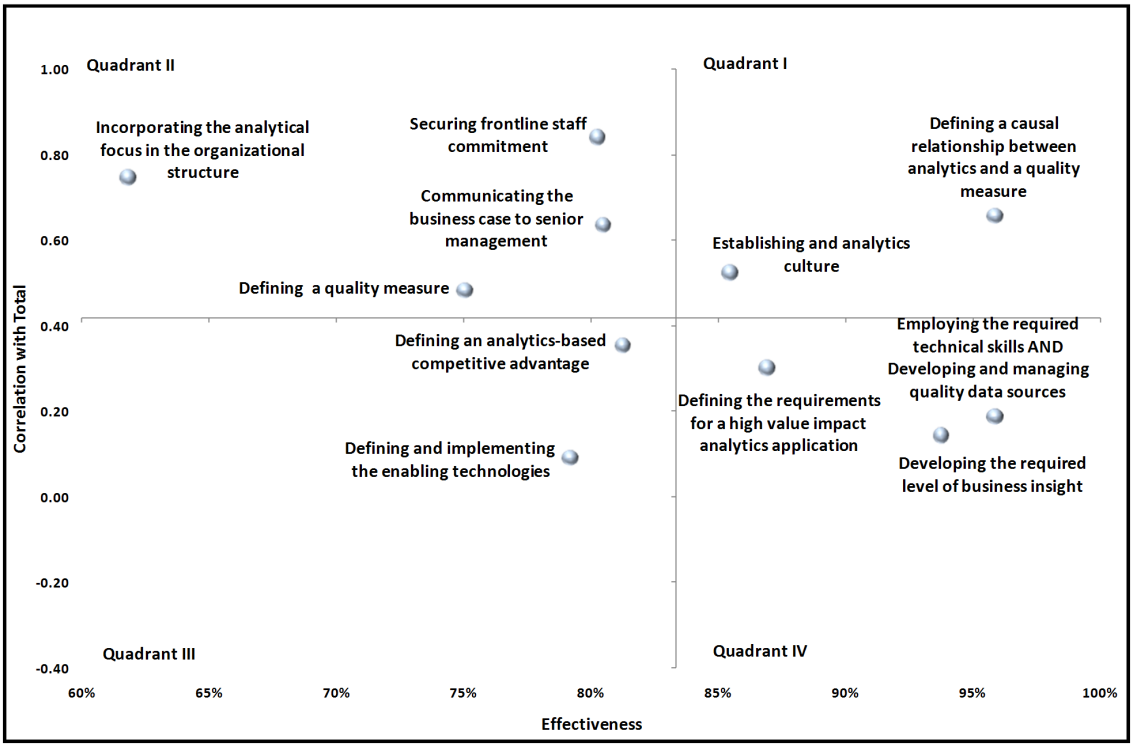

Figure 5.1: Analysis of strategy sections

sections of the strategy require drastic improvement. They will also remain in the main body of the strategy document due to their high correlation with the total score.

- Strategy sections that are grouped in the third quadrant do not have as much influence on the overall decision to implement the strategy or not. In addition the main issues in these sections have not been effectively addressed. These sections of the strategy need to be improved. Due to their low correlation with the total score, these sections can be presented in summary format and moved to an addendum to the main body of the strategy document.
- The sections in the strategy document that are grouped in the fourth quadrant were effective in dealing with the issues that restrict the application and integration of advanced analytics. These sections can be further refined and summarized and may be moved to an addendum to the main strategy document if appropriate.

5.4 Defining an analytics-based competitive advantage

The approach followed in the initial strategy document was that a sustainable competitive advantage is a key component of a company's ability to create shareholder value. The ability to optimize key decision processes in a company does represent a competitive advantage and such an advantage can be created by developing advanced analytic capabilities in a company.

Summary of qualitative feedback

- Even within the relatively narrow framework of decision optimization there were different interpretations as to how an analytics-based competitive advantage could be created.

- Some members of the team felt that decisions are based on a basic set of business rules and that these decisions cannot be differentiated from one business to the next.
- In contrast, others felt that decision optimization will equip managers to make informed, relevant and efficient decisions which represents the only competitive advantage that can be created in today's business world.
- The ability to develop and implement advanced analytics applications that can optimize decision processes is in itself a competitive advantage only if competitors are not doing the same and the proposed applications can be effectively implemented in practice.

Quantitative analysis

A summary of the quantitative analysis relating to the definition of an analytics-based competitive advantage is presented is Table 5.1 and Table 5.2.

	Effectiveness	**Correlation**	**Quadrant**
Defining an analytics-based competitive advantage	81%	0.36	3

Table 5.1: Analysis of strategy section: Defining an analytics-based competitive advantage

- The effectiveness of this section of the strategy document in convincing the senior team that the ability to optimize key decision processes represents a competitive advantage and that such an advantage can be created by developing advanced analytics capabilities is set at 81 percent which is lower than the median of 83 percent.
- This, in combination with a correlation with the total score of 0.36 places this section in the third quadrant.

Question Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
2	Are you convinced that the ability to optimize decision processes represents a competitive advantage?	88%	0.73	1
3	Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?	75%	0.04	3

Table 5.2: Analysis of related questions: Defining an analytics-based competitive advantage

- The strategy was 88 percent effective in convincing the senior team that the ability to optimize decision processes represents a competitive advantage.
- This is higher than the median at 83 percent and in combination with a correlation coefficient with the total score of 0.73 this question is placed in the first quadrant.
- In contrast the strategy was only 75 percent effective in convincing the team that a sustainable competitive advantage can be created by developing capabilities that will allow the company to optimize key decision processes.
- The correlation coefficient with the total score is much lower than the median at 0.04 which places this question in the third quadrant.

Discussion

- In general the senior team was not convinced that a sustainable competitive advantage can be created by developing capabilities that allow for the optimization of key decision processes. This is partly due to a lack of clarity related to the concept of decision optimization.
- Because of this lack of clarity the senior team is skeptical about the concept and would require a robust proof of concept before further consideration will be given to the implementation of an advanced analytics initiative.

Recommendations

- The discussion of competitive advantage must be introduced at a later point in the strategy document. It should preferably follow once the value impact of the proposed decision optimization applications has been presented.
- Using this sequence the potential to create a competitive advantage will be introduced once the concept applications have been tested in terms of their ability to increase shareholder value.
- Using the concept applications the idea of decision optimization and its ability to create a sustainable competitive advantage can then be explained through reference to practical examples.
- Discussion of the competencies that were required to develop the concept applications will give the team an indication of whether the internal development of these competencies will be feasible for the holding company or not.

5.5 Defining the impact of analytics

This main section includes the following subsections:

- Defining a quality measure, and
- Defining the causal relationship between analytics and a quality measure.

5.5.1 Defining a quality measure

The approach followed in the first advanced analytics strategy was that intrinsic value can be regarded as a quality measure of a business' value creating ability especially in situations where its significant ability to predict market value is strengthened through effective investor communications. It is arguably the best measure to use for measuring the impact of analytics initiatives on the shareholder value of a company.

Summary of qualitative feedback

- Intrinsic value is seen as a useful measurement of company performance. There is a perception that its calculation requires a lot of assumptions and that it is therefore never precise. Because of this, respondents are not entirely comfortable with using it as the only measurement of impact.
- There is also a perception that it would be difficult to isolate the impact of an analytics initiative on intrinsic value. This is because the annual future profit, and therefore the

intrinsic value, is influenced by a wide range of factors which may or may not include the impact of analytics initiatives.

- The economic profit definition of intrinsic value is not clearly understood. Respondents are looking for classic discounted free cash flow variables such as the impact of future capital replacements and expansion as well as capital required to maintain working capital.
- There is a definite preference for accounting measures such as return on equity (ROE)
- Intrinsic value is seen as a good indicator of market value. This is because intrinsic value reduces the subjective perception of a share's value, intrinsic value is a clear indicator of a company's financial health which is reflected in its market value, and where all facts are known intrinsic value will closely track market value.
- Intrinsic value will deviate from market value in cases where a premium is paid for acquired and strategic value or where the shareholder profile is dominated by unsophisticated investors and share trade volumes are low.

Quantitative analysis

A summary of the quantitative analysis related to defining a quality measure is presented in Table 5.3 and Table 5.4.

	Effectiveness	**Correlation**	**Quadrant**
Defining a quality measure	75%	0.48	2

Table 5.3: Analysis of strategy section: Defining a quality measure

- The initial strategy was 75 percent effective in convincing the senior team that intrinsic value is the best measure to use for measuring the impact of analytics initiatives on the shareholder value of a company.
- The low effectiveness score combined with a correlation coefficient of 0.48, which is higher than the median of 0.42, places this section in the second quadrant.

Question Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
4	How convinced are you that intrinsic value should be used to measure the impact of advanced analytics initiatives?	63%	0.73	2
5	How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?	88%	0.25	4

Table 5.4: Analysis of related questions: Defining a quality measure

- The current strategy was only 63 percent effective in convincing the senior team that intrinsic value should be used to measure the impact of advanced analytics initiatives. Due to its correlation coefficient of 0.73 this question is placed in the second quadrant.
- In contrast, the team is quite convinced (88 percent) that intrinsic value is a good predictor of market value. The low correlation coefficient of this question with the total places it in the fourth quadrant.

Discussion

- Intrinsic value is perceived to be an imprecise measurement of the potential impact of an

analytics application

- The reality is that intrinsic value is a complex measure that is based on a number of variables which in turn is based on an even larger variable set.
- The senior team would be more comfortable with less complicated impact measures such as changes in the operating capital base, changes in operating profit or changes in the cost and contribution of debt and equity in the financing structure of the company.
- Using these variables as impact measures it would be easier to isolate the impact of an analytics project.
- It is important to clearly demonstrate how these variables are linked to the key value drivers such as return on invested capital and weighted average cost of capital which in turn are used to calculate economic profit.
- It is also important to show the impact of changes in economic profit on intrinsic value since the team is convinced that intrinsic value is a good predictor of market value.

Recommendations

- A properly constructed valuation model will allow for the measurement of the impact of an analytics application on the various sub-levels of intrinsic value such as operating profit, capital efficiency, revenue growth and the cost of capital.
- The valuation model will also enable the analyst to isolate the impact by comparing the forecast values of these variables with and without the proposed decision optimization application.
- The valuation model will also show how the changes in return on invested capital and weighted average cost of capital will impact economic profit and relate the change in economic profit to the change in intrinsic value.
- The level at which the potential value impact of an analytics intervention will be measured must be defined in the introduction to the business case.

5.5.2 Defining the causal relationship between analytics and a quality measure

The approach followed in the first strategy was that there is a causal relationship between decision optimization and shareholder value creation and that the potential lack of decision quality in a company represents a tremendous opportunity if value driving decisions can be optimized.

Summary of qualitative feedback

- The ability to make correct and timely decisions will have a positive impact on profits. Optimizing decisions will therefore lead to increases in profits which will lead to an increase in shareholder value. This will only be possible if decision optimization can be practically implemented.
- Good decisions will lead to higher returns on capital, increased economic profit and an increase in shareholder value.
- Good decisions are a function of the quality of the data on which they are based. A lack of quality information will therefore lead to bad decisions.

- Decision optimization will provide more structure to decision making processes and this will in turn have a positive impact on shareholder value.
- The more management is equipped with strategic tools the better they will be able to perform.
- Since bad decisions can have a direct impact on outcomes it is logical that an improvement in decision processes will result in improved performance.

Quantitative analysis
A summary of the quantitative analysis related to the the causal relationship between analytics and a quality measure is presented in Table 5.5 and Table 5.6.

	Effectiveness	**Correlation**	**Quadrant**
Defining a causal relationship between analytics and a quality measure	96%	0.66	1

Table 5.5: Analysis of strategy section: Defining a causal relationship between analytics and a quality measure

- The strategy was 96 percent effective in motivating the causal link between analytics and shareholder value.
- This section has a correlation coefficient of 0.66 which is higher than the median of 0.42.
- This combination places the section in quadrant one which means that the main issue has been adequately addressed in the initial strategy.

Question Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
6	How convinced are you that decision optimization will lead to an increase in shareholder value?	92%	0.66	1
7	How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?	100%	0.00	4

Table 5.6: Analysis of related questions: Defining a causal relationship between analytics and a quality measure

- The strategy was effective (100 percent) in convincing the senior team that the lack of decision quality represents a real opportunity for performance improvement.
- The strategy was also 92 percent effective in convincing the senior team that decision optimization will lead to an increase in shareholder value.
- The high effectiveness of the strategy at convincing the senior team that decision optimization will lead to an increase in shareholder value combined with a relatively high correlation coefficient of 0.66 places this question in the first quadrant which implies that it has been adequately addressed in the initial strategy

Discussion

- Although convinced that there is a causal relationship between decision optimization and shareholder value the understanding of the causal relationship is quite varied.
- The potential financial impact of analytics is described in terms of profit, return on invested

capital, and an increase in economic profit. All of these are said to have a positive impact on shareholder value.

- Decision optimization initiatives may improve the structure of decision making leading to increased levels of management performance.
- The relative importance of this section suggests that it should be refined, bearing in mind that it is already in the first quadrant which implies that the senior team is convinced that the main issue in the section has been adequately addressed.

Recommendations

- This section must be included in the introduction section to the business case.
- The explanation of the link between decision optimization and increased shareholder value can be enhanced by including a graphic representation of the shareholder value chain.

5.6 Defining and implementing the required organizational changes

This section of the strategy document includes the following subsections:

- Incorporating the analytical focus in the organizational structure
- Establishing an analytics culture
- Developing or employing the required level of business insight
- Developing or employing the required technical skills

5.6.1 Incorporating the analytical focus in the organizational structure

The approach followed in the first advanced analytics strategy was that the establishment of a centralized analytics department is seen as the most effective and progressive approach to the incorporation of an analytics focus into a company's organizational structure. The practical implication would be that a company would need to appoint a senior manager, an analytics department manager, and a whole new analytics department to effectively implement an advanced analytics strategy.

Summary of qualitative feedback

- The viewpoints relating to a centralized analytics department separate from IT and a senior management resource that is responsible for analytics are varied.
- The first view is that the current management team must take responsibility for optimizing the decision processes in their various divisions or businesses since they are the ones that know the reality of their businesses. Optimality can be achieved through the implementation of analytics applications that are easy to maintain and use. An analytics specialist can be appointed and can work with the current IT team but will not report to the IT manager due to the specialist nature of the work.
- The second view holds that future internalization of analytics through the establishment of an analytics department may be considered based on the initial successes that are realized by external consultants.

- The third view agreed with the suggestion of establishing an internal analytics department based on the fact that analytics is a specialized area and that a separate department will be more focused with clear ownership and a higher ability to meet objectives. The total expense associated with the proposed structure is seen to be too high.
- There should be a close relationship between IT and Analytics with the potential of training current IT resources to accommodate some or all of the required analytics competencies. In addition to the close relationship with IT the analytics department must also work closely with finance.
- A senior manager that has the autonomy to implement and execute strategy must drive the analytics initiative in the company.
- The proposed reporting lines of the senior management role vary between reporting directly to the Group Managing Director (GMD) and reporting to the Group Financial Director (GFD).
- The motivations for reporting directly to the GMD is that it will ensure buy in, it will be a means of escalating the importance of analytics, and it would be in line with the increasingly important role of information technology in the business.
- A reporting line to the GF) is considered because the GFD will have the most need for an analytics specialist. This is because the GFD is tasked with finding additional improvement opportunities in the current planning cycle. The GFD knows the potential impact areas across the businesses and can translate the results of analysis to facilitate implementation.
- The senior manager must take responsibility for both the IT as well as the analytics departments. Interaction between the two departments is important since it will facilitate the implementation of analytics initiatives.
- If an analytics department is established it will have to start small. Additional personnel may be added as the initiative realizes bankable impact.
- A centralized analytics department will only be considered if the annual contributions to the profitability of the company are at least double the annual personnel costs associated with the department.

Quantitative analysis

A summary of the quantitative analysis related to the incorporation of the analytical focus in a company's organizational structure is presented in Table 5.7 and Table 5.8.

	Effectiveness	**Correlation**	**Quadrant**
Incorporating the analytical focus in the organizational structure	62%	0.75	2

Table 5.7: Analysis of strategy section: Incorporating the analytical focus in the organizational structure

- The current strategy was not effective in convincing the senior team that the proposed organizational structure is the right way to go.
- The effectiveness rating for this section is the lowest at only 62 percent, which is lower than the median of 83 percent.
- This low level of effectiveness combined with a high correlation coefficient of 0.75 places it in the second quadrant.

- It is regarded as one of the most important aspects of the initial strategy that requires attention.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
8	How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?	54%	0.71	2
9	How convinced are that the company should appoint a senior manager to drive the analytics agenda in the company?	63%	0.64	2
16	Are you convinced that the newly created senior management role should report directly to the Group Managing Director?	88%	0.70	1
17	Are you convinced that the IT Manager and the Analytics Department Manager should both report to the newly created senior position?	75%	0.52	2
19	Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?	42%0.62	2	
18	Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?	50%	0.00	3

Table 5.8: Analysis of related questions: Incorporating the analytical focus in the organizational structure

- The senior team is convinced (88 percent) that the senior manager should report directly to the GMD. The high correlation between this question and the total score together with the high effectiveness rating, places it in the first quadrant which suggests that this aspect has been adequately addressed in the initial strategy.
- In general, the senior team is not convinced (54 percent) of the need for a centralized analytics department. This low effectiveness score combined with a correlation coefficient of 0.71 places this question in the second quadrant.
- The strategy was more effective (63 percent) in convincing the senior team that a senior manager responsible for analytics is needed. The correlation coefficient of 0.64 is higher than the median and this question is placed in the second quadrant.
- Due to the size of the proposed analytics department and the high annual salary bill associated with it, the team is not convinced (42 percent) that it is worthwhile for the company to commit to the proposed department structure. The low effectiveness score of the proposed approach combined with a correlation coefficient of 0.62 places this question in the second quadrant.
- The senior team is more convinced (75 percent) about letting both IT and analytics report to a senior manager. This in combination with a correlation coefficient of 0.52 places this question in the second quadrant.

- The senior team is not convinced (50 percent) that the proposed structure is aligned with the focus on decision optimization mainly because they do not have previous exposure to any of the proposed positions in the organizational diagram presented for the analytics department.

Discussion

- The section of the strategy relating to the required organizational changes was one of the more important, yet least convincing sections of the initial advanced analytics strategy.

- The feedback from the senior team suggested that the organizational structure may vary between not having any internal analytics resources to having a small analytics department that works closely with the current IT department but without a formal reporting relationship into IT. If such a department is established there is a high probability that it will be functionally aligned with either finance or the largest operating division of the business. The focus will be wider if the alignment is within finance since divisional alignment will most probably result in the analytics department having exclusive focus on divisional matters.

- The implication of having no internal analytics resources as oppose to having an analytics department is that the company will have to maintain a relationship with an external analytics provider which may dilute the potential for creating a sustainable competitive advantage. The nature of this relationship may vary between consulting and outsourcing.

- In between the two extremes is the option of an internal resource that will be responsible for the development and implementation of the analytics strategy using mainly external resources. There is some difference of opinion relating to the seniority of this individual.

- The reporting relationship of an internal analytics representative, whether the individual is heading up the department or working solo, is still a matter of debate. There seems to be equal preference for this person reporting to either the GFD or the GMD. The potential reporting line does depend on the seniority of the internal analytics resource.

- The senior team is not prepared to commit to a high cost analytics department. The level of analytics internalization will depend on measurable results delivered using external resources. As the measurable impact of analytics projects become more apparent the company will commit to increased levels of analytics internalization.

Recommendations

- A phased approach to the internalization of analytics must be followed. The phases must be linked to the successful completion of high value impact analytics initiatives.

- Initially, the first project may be handled exclusively by external resources. As the projects increase in terms of scope an impact, additional resources such as a senior manager responsible for analytics may have to be appointed.

- Alternatively, the analytics function can be outsourced.

- Due to its importance this section of the strategy will remain part of the main strategy document. It will only be included at the end as a key component of realizing the value impact which will be detailed earlier in the strategy document.

5.6.2 Establishing an analytics culture

The approach followed in the initial advanced analytics strategy was that the best way of establishing an analytics culture is to get commitment at senior management level. This commitment can be realized through the appointment of a senior manager responsible for analytics.

Summary of qualitative feedback

- There is general agreement that it is important to establish an analytics culture at all levels of the company.
- If analytics is not part of the culture of the company, analytics initiatives will not be implemented, since there will be no ground level participation or buy in due to people not believing or trusting the initiative.
- There are two views relating to the establishment of an analytics culture in the company.
- The one view is that such a culture will be established by the senior management team and will not be realized through the appointment of a senior manager responsible for analytics. The GMD and his team must believe in the strategy and drive it at every opportunity by demonstrating its advantages. Only if there are enough repeatable advantages will the appointment of a senior manager responsible for analytics, be considered.
- The alternative view is that a senior manager must be appointed since this type of initiative must be driven from the top down. Heading an analytics department requires specialized skills, and the current senior management team does not have the skill set to effectively drive the initiative.

Quantitative analysis

A summary of the quantitative analysis that relates to the establishment of an analytics culture is presented in Table 5.9 and Table 5.10.

	Effectiveness	**Correlation**	**Quadrant**
Establishing an analytics culture	85%	0.53	1

Table 5.9: Analysis of strategy section: Establishing an analytics culture

- The current strategy was relatively effective (85 percent) in convincing the senior team that the establishment of an analytics culture has been effectively addressed.
- The correlation coefficient of this section is higher than the median at 0.53 which places the section in the first quadrant.

Qestion Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
10	How convinced are that establishing an analytics culture in the company will be important for the successful application of advanced analytics?	100%	0.00	4
11	How convinced are you that the most effective way of establishing such a culture could be through the appointment of a senior manager who must drive the analytics agenda?	71%	0.53	2

Table 5.10: Analysis of related questions: Establishing an analytics culture

- The senior team is 100 percent convinced that establishing an analytics culture in the company is important.
- They are less convinced (71 percent) that the most effective way of establishing such a culture would be through the appointment of a senior manager who will drive the analytics agenda.
- The question related to an analytics manager driving the strategy has a correlation coefficient of 0.53 which places it in the second quadrant.

Discussion

- The way in which an analytics culture will be established and radiated throughout the company will depend on the decision related to the appointment of a senior analytics manager.
- The two views held by the senior team is indeed complementary and not directly in opposition of each other. Establishing an analytics culture in the organization will not be a one person effort. It will require a committed effort from the current senior management team.
- Under the expert guidance of a specialist the effort in establishing an analytics culture can be much better directed realizing a higher level of impact.
- Without this resource the current leadership team will need to dramatically increase their level of knowledge of analytics and more specifically their knowledge and understanding of what is realistically possible in terms of decision optimization.

Recommendations

- Establishment of an analytics culture does not have to be presented as a separate issue. The issue of demonstrated senior management commitment can be incorporated in an advanced analytics skills development framework. This framework compares current and required skills and maps out a development and talent acquisition program.
- Management commitment must also be communicated to the application user base preferably during formal application training sessions.

5.6.3 Developing the required level of business insight

The approach followed in the first strategy was that an analytics department can achieve the required level of business insight by developing or employing valuation modeling and value management skills. The ability to view the business from an investors perspective will result in analytics interventions that are aligned with the core objective of any for profit company namely, shareholder value creation.

Summary of qualitative feedback

- Business insight leads to higher quality models since the quality of the assumptions on which these models are based is a function of the business insight demonstrated by the analyst.
- Detailed knowledge and understanding of the business will lead to an accurate implementation of an analytics strategy.
- Business insight ensures relevance, effective prioritizing of interventions, and accurate interpretation of results.

- In terms of gaining the required level of business insight in the analytics department there are three divergent views. The first view holds that the best way to gain such a skill set would be to employ or develop value management skills in the company. The second view holds that these skills should be outsourced and the third view holds that these skills should be employed rather than developed.

Quantitative analysis

A summary of the quantitative analysis that relates to the development of the required level of business insight in the analytics department is presented in Table 5.11 and Table 5.12.

	Effectiveness	**Correlation**	**Quadrant**
Inability to develop or employ the required level of business insight	94%	0.14	4

Table 5.11: Analysis of strategy section: Developing the required level of business insight

- The strategy was 94 percent effective in convincing the senior team that the suggested approach effectively deals with establishing the required level of business insight in an analytics department.
- This section is weakly correlated with the total score with a correlation coefficient of 0.14 which places the section in the fourth quadrant.

Question Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
12	Are you convinced that the analytics department must have business insight to effectively deliver value to the company?	100%	0.00	4
13	Are you convinced that the best way to gain this insight is to employ or develop value management skills?	88%	0.14	4

Table 5.12: Analysis of related questions: Developing the required level of business insight

- The senior team is convinced (100 percent) that an analytics department must have business insight to effectively deliver value to the company.
- They are less convinced (88 percent) that the way to develop such insight would be to employ or develop internal value management skills.
- Both questions are placed in the fourth quadrant based on correlation coefficients of 0.00 and 0.14 respectively.

Discussion

- The senior team is convinced that the analytics department must have value management skills but this does not play a significant role in the advanced analytics implementation decision. Having business insight may be regarded as a given or a basic requirement for the department to do any meaningful work.
- Value management provides an investor perspective of the business. Thus, the key value drivers that are used to motivate and measure analytics interventions can be directly related back to shareholder value.

- The financial model that is used in the business case for a particular intervention must be a valuation model to allow for the analysis and measurement of the potential impact on shareholder value. This will only be possible if the analytics department has valuation modeling skills.
- Value management is a well-developed and practical discipline and requires knowledge of a wide range of subjects such as financial accounting, financial management, cost accounting, and strategic planning.

Recommendations

- This section in the strategy document can be reduced and combined with another section that specifically relates to the required skill set of the analytics department.
- The following aspects need to be emphasized:
  - The investor-focus that results from approaching an opportunity or problem from a value management perspective,
  - The fact that value management and valuation modeling allow the analyst to link value drivers with shareholder value performance, and
  - The high quality of financial modeling that is inherent to a well structured valuation model.

5.6.4 Developing and employing the required technical skills

The approach followed in the first strategy was that the focus of an analytics department determine the required technical skill set. If the analytics department is focused on optimizing key decisions then the technical skill set of the department must include optimization, software development, and data management and analysis skills

Summary of qualitative feedback

- Having optimization modeling skills in the analytics department is important because these skills form the basis of optimization modeling and are therefore critical for success. Having these skills will ensure high impact solutions.
- The technical nature of the solutions require specialized skills but it is important that the technical skill set be supplemented with the knowledge and insight of subject matter experts with reference to a particular decision process.

Quantitative analysis
A summary of the quantitative analysis that relates to the development and employment of the required technical skills in the analytics department is presented in Table 5.13 and Table 5.14.

	Effectiveness	**Correlation**	**Quadrant**
Developing and employing the required technical skills	96%	0.19	4

Table 5.13: Analysis of strategy section: Developing and employing the required technical skills

- The strategy was 96 percent effective in convincing the senior team that the analytics department must employ the correct mix of technical skills to be effective.

- Due to its low correlation coefficient of 0.19 it is placed in the fourth quadrant.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
14	Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?	96%	0.19	4

Table 5.14: Analysis of related questions: Developing and employing the required technical skills

- The senior team was convinced (96 percent) that optimization skills are an important skill set of an analytics department that is focused on decision optimization.
- The high effectiveness score in combination with a low correlation coefficient of 0.19 places this question in the fourth quadrant.

Discussion

- The low correlation coefficient is a consequence of the senior team's view on employing analytics professionals in the organization. Since the current view leans towards using external analytics resources the technical skills requirement of an internal analytics department is not of any major concern to the decision makers of the company at the moment.
- This does not mean that the technical skills of the external analytics provider are not important. To be effective at decision optimization the analytics team must have optimization skills as part of its core skill set.

Recommendations

- This section can be scaled down in the next version of the advanced analytics strategy.
- The senior team only needs to be assured that the correct mix of technical skills will be in place to effectively deliver on the proposed analytics interventions.
- The required technical skills will be specified in a skills development framework which will support recommendations related to potential organizational changes. The skills development framework can be included as an addendum to the main strategy document.

5.7 Developing and implementing a high impact analytics intervention

This section of the strategy includes the following subsections:

- Communicating the business case to senior management.
- Developing and managing quality data sources.
- Defining and implementing the enabling technologies.
- Defining the requirements for a high value impact analytics application.
- Securing front line staff commitment.

5.7.1 Communicating the business case to senior management

The approach followed in the first advanced analytics strategy was that a potential framework for communicating a business case within the context of value management and decision optimization will include the following main sections:

- Assessment of the historical value creating ability of the business.
- Identification and prioritizing of value creating opportunities.
- Assessment of key underlying decision processes.
- The specification of high value impact analytics applications.
- Project team structure, main work streams and time frames.
- Quantification of the net value impact of the proposed interventions.

Summary of qualitative feedback

- The section in the business case that focused on the historical value creating performance of a particular subsidiary company is in line with actual figures and analysis of the performance of the company. It does neglect to discuss the impact of macro-economic factors, industry dynamics, legislative changes and changes in the management structure.
- The factors that contributed to the weak value creating performance of the business in the past has been correctly identified and are in line with key focus areas included in the strategic plans of the subsidiary company. Other factors include declining sales volumes, market dynamics and the range of inventory items held by the company to support its unique selling proposition. There is also a view that management played a role in the company's decline.
- There is general agreement that the value creating ability of the company will improve by focusing on pricing, inventory acquisition and inventory holding levels. Potential price increases are limited hence the philosophy that profit is bought not sold. Profit is therefore a function of purchasing efficiency rather than pricing. Other aspects that play a role are marketing and distribution efficiency. Improved efficiencies must be complimented with new market opportunities that support growth.
- There are two views relating to the optimality of the current pricing process. The first view holds that the pricing process was sub-optimal for the following reasons:
  - It is focused on improving the gross profit expressed as a percentage of sales, as oppose to gross profit expressed in value with the result that stock acquisition efficiencies translated into better an improved gross profit percentage, but lower sales prices.
  - The process is in need of structure based on policy and guidelines.
  - The pricing variations associated with the pricing process resulted in varying and unpredictable gross profit margin fluctuations.
  - The changing customer profile of the business also contributes to inefficiencies in the pricing process. Customers that purchase products using a tender process require a different approach to pricing.
- The second view holds that if the complexity of the pricing decision is taken into consideration then the current market pricing efforts can be seen as relatively effective.

- There are two views on the potential impact related to an improved price management process. The first view is that the proposed changes will improve the process because similar changes were implemented during the previous year and it realized positive results. The company will gain control over its margins, improve its planning ability and create an environment for pro-active pricing corrections. The second view holds that sales are already made at a level determined by the market and that price management can be improved by merely paying representatives incentives on gross profit value. Any proposed changes to the pricing process will also be dependent on market conditions and management experience.
- The price management system must take market price or the potential selling price into consideration. At the moment this is not clearly indicated in the proposed system's description.
- The proposed mechanism for price increases may be unacceptable for most customers since it will introduce price uncertainty and complicate their planning process. A potential solution may lie in structured price discounts based on volume and purchase frequency.
- The management of stock acquisition and distribution is challenging due to uncertainty of demand, the increase in tender-based sales, and the large number of inventory items that are being carried. This complexity certainly contributes to inefficiencies that result in double handling and service delivery issues.
- Here again two distinct views were identified. The first view holds that the proposed changes to the inventory acquisition and management process will reduce inefficiencies as long as it is tightly integrated with the ERP systems of the company. This improvement will be the result of increased structure in the decision process. The second view holds that the inventory acquisition and management process is less important and that factors such as exchange rate fluctuations and growth in tender business will play a larger role in determining acquisition costs and stock holding levels. The proposed process may not be able to accommodated tender business.
- The senior team was of the opinion that the proposed inventory acquisition and planning system was thoroughly considered because it effectively addresses uncertainty, is well thought through and is based on considerable investigation of the problem.
- The information provided on the proposed project team's ability to deliver on the project was not enough for the respondents to evaluate and comment on it. Additional factors that will play a role are the level of buy in, time frames, costs and people issues.
- The main project work streams suggest that the decision optimization project for the subsidiary company be rolled out at branch level or distribution center level. There is a level of uncertainty related to the practicality of this approach.
- Respondents do not have enough information to judge the time frames that have been presented relating to the main project work streams.
- There is a general feeling that the suggested value improvement that can be realized in this project is overly optimistic. The forecast improvements in gross profit percentage must be tempered by market and macro economic constraints, the potential impact of labor unrest, potential closure of suppliers and client businesses, and the company's ability to tender for contracts as determined by its black economic empowerment profile.

Quantitative analysis

A summary of the quantitative analysis that relates to the communication of a business case to senior management is presented in Table 5.15 and Table 5.16.

	Effectiveness	Correlation	Quadrant
Inability to effectively communicate the business case to senior management	80%	0.64	2

Table 5.15: Analysis of strategy section: Communicating the business case to senior management

- The strategy was not effective in communicating the business case to senior management.
- The senior team was only 80 percent convinced which is lower than the median of 83 percent. The high correlation coefficient of this section's with the total score of 0.64 places this section of the strategy in the second quadrant.
- This means that the business case will be an important focus area when formulating the improved advanced analytics strategy for the second research cycle.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
34	How convinced are you that the preceding section accurately accurately represents the historical value creating ability of the Subsidiary Company?	67%	-0.08	3
35	How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?	88%	-0.25	4
36	How convinced are you that the Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?	92%	-0.13	4
37	How convinced are you that the current price management decision process is sub-optimal?	79%	0.47	2
38	How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?	88%	0.45	1
39	How convinced are you that the current inventory acquisition and management decision process is sub-optimal?	71%	0.22	3
40	How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?	96%	-0.36	4
41	How convinced are you that the Price Management System has been thoroughly considered?	83%	0.70	2

Question Nr.	Question	Effectiveness	Correlation	Quadrant
42	How convinced are you that the Inventory Acquisition and Management System has been thoroughly considered?	83%	0.70	3
43	Are you convinced that the proposed project team will be able to deliver on the project?	79%	0.46	2
44	Are you convinced that these are indeed the next steps to get the project going?	83%	0.81	2
45	How convinced are you that the delivery time frames are realistic?	67%	0.60	2
46	Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?	71%	0.35	3

Table 5.16: Analysis of related questions: Communicating the business case to senior management

- There are a number of aspects in the business case that must be improved in the next cycle of strategy refinement. These aspects relate to questions that are allocated to the second quadrant. A number of aspects relate to the project plan and includes planning elements such as work streams, time frames, and the structure of the project team. Other aspects that are allocated to the second quadrant relate to the proposed interventions. Here the reasoning behind and the format of the proposed interventions need to be strengthened.
- Aspects that are allocated to the third quadrant relate to the assessment of the historical value creating ability of the company as well as the estimated value impact of the proposed solutions. The analysis that supports these sections of the strategy need to be improved to deliver better insight and improved impact assessment.
- Fourth quadrant aspects all relate to the assessment of the historical value creating performance of the business. These have been well motivated and may only require some refinement.

Discussion

- The historical value creating performance, informed by macro-economic and industry trends, is an essential determinant of the focus of the analytics intervention. The focus is determined by a company's historical return on invested capital performance. If a company's return on invested capital is higher than the weighted average cost of capital, the focus should be on growth. If the company's return on invested capital is lower than the weighted average cost of capital then the company must focus its efforts on improving operating profitability or increasing capital efficiency.
- The historical value creating performance as well as the prioritizing of focus areas for value improvement provides an essential framework for guiding the type of intervention that is required.
- The method used to demonstrate the potential impact of the analytics project in the current strategy document was unconvincing.
- The decision analysis framework that was used to assess the decision process underlying high value impact areas of the business was also unconvincing.

Recommendations

- The projected value impact requires stronger motivation. A more robust impact assessment based on back testing the application on historical data and then determining the value impact of any improvements will have to be developed.
- The focus for the first cycle of strategy improvements should be on more effectively convincing the senior team that all aspects related to the project plan have been thoroughly considered. These include the structure of the project team, an overview of the main work streams and their associated time frames.
- A more direct and compact method for analyzing decision processes must be devised.
- It is important to improve the general flow of the business case and be sure to exclude those aspects of strategy development that are important in terms of their input but less important in terms of their influence on the final decision. These important sources of strategy input should be included in an addendum to the main document.
- The main aspects of the next version of the advanced analytics strategy should be the establishment of business focus and relevance, development and testing of concept applications, and the transfer of selected concept applications into production.

5.7.2 Developing and managing high quality data sources

The approach followed in the initial advanced analytics strategy was that there are two main approaches to data. These are the data centric approach which holds that data is the primary focus of analytics initiatives or the application centric approach which holds that data is an enabler of integrated analytics applications. The approach to data management is again a function of the primary focus of the analytics department. If the focus is on the development and implementation of decision optimization applications the department will follow an application centric approach to data management.

Summary of qualitative feedback

- Respondents did not seem to understand this section. They emphasized data accuracy and focusing efforts on a selected number of applications.
- This section of the strategy was clearly not effective in contrasting a data centric approach with an application centric approach when developing and implementing an advanced analytics strategy.

Quantitative analysis
A summary of the quantitative analysis that relates to the development and management of high quality data sources is presented in Table 5.17 and Table 5.18.

	Effectiveness	**Correlation**	**Quadrant**
Developing and managing quality data sources	96%	0.19	4

Table 5.17: Analysis of strategy section: Developing and managing quality data sources

- The senior team is convinced (96 percent) that the initial strategy adequately addressed the issue of data quality.

- The correlation coefficient for this section is low at minus 0.19 which places it in the fourth quadrant.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
20	How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?	96%	0.19	4

Table 5.18: Analysis of related questions: Developing and managing quality data sources

- The initial strategy was effective (96 percent) in convincing the team that the best approach to data management is to concentrate on the data requirements of specific analytics applications.
- The effectiveness score combined with a low correlation coefficient places this question in the fourth quadrant.

Discussion

- The current strategy was not effective in contrasting a data centric approach to data management with an application centric approach. The advantages related to an application centric approach were not clearly presented.
- The most important advantage of an application centric approach is the potential of delivering a high impact solution within a relatively short time frame. This is possible due to data efforts that are focused on the requirements of a particular application.
- The eventual data integration requirement may only come once two or more working applications are already realizing optimum decisions for the business. Data integration can be run as a parallel work stream that changes in scope as new applications are developed and rolled out.

Recommendations

- The section on data in the strategy document must be strengthened to clearly demonstrate the differences between the data centric and application centric approach.
- It must list the advantages and disadvantages associated with each approach.
- The section must also address the issue of data integration and show how the required level of data integration will be achieved as the number and complexity of the advanced analytics applications increase over time.
- The approach to data management must be detailed in an addendum that governs the principles on which the development of decision optimization applications are based.

5.7.3 Defining and implementing the enabling technologies

The approach followed in the first strategy was that most companies will be faced with the decision to implement an advanced analytics platform at some stage of strategy implementation. There are well developed guidelines that will be invaluable when making this decision.

Summary of qualitative feedback

- If the company does decide to standardize on an analytics platform it must be integrated with the ERP solution.
- Standardization on an analytics platform will only be considered if there are real opportunities for increased profit based on the effective realization of savings that are at least five times as much as the required investment.
- The decision to invest in an analytics platform is dependent on the establishment of an analytics department in the company.

Quantitative analysis

A summary of the quantitative analysis related to the definition and implementation of enabling technologies is presented in Table 5.19 and Table 5.20.

	Effectiveness	**Correlation**	**Quadrant**
Defining and implementing the enabling technologies	79%	0.09	3

Table 5.19: Analysis of strategy section: Defining and implementing the enabling technologies

- The strategy was not effective (79 percent) in addressing the issue related to the effective identification and implementation of enabling technologies.
- This, in combination with a weak correlation coefficient of 0.09 places the section in the third quadrant.

Question Nr.	**Question**	**Effectiveness**	**Correlation**	**Quadrant**
15	Are you convinced that the company will have to invest in an analytics platform?	79%	0.09	3

Table 5.20: Analysis of related questions: Defining and implementing the enabling technologies

- The strategy was not effective (79 percent) in convincing the team that the company needs to invest in an analytics platform.
- This, in combination with a weak correlation coefficient of 0.09 places the question in the third quadrant.

Discussion

- There are two reasons for the low correlation coefficient of this section with the total: In the first place the implementation of an analytics platform is only really important for the company if it has its own analytics department, an option that is not well supported by the senior team. Secondly, even if an analytics department is established, the choice of an analytics platform is a technical issue and will be made by individuals other than the members of the senior team.
- The result is that choice of analytics platform will not have an impact on the overall decision related to the implementation or not of an advanced analytics strategy.

Recommendations

- The Gartner framework for the assessment of advanced analytics platform vendors is a valuable resource when evaluating potential alternatives. This framework can be included

as an addendum to the main strategy document.

5.7.4 Defining the requirements of a high value impact analytics application

The approach followed in the first strategy was that successful analytics applications are based on a set of principles that will have a direct impact on their successful deployment and effective use. These principles are business relevance, integration, transparency, ease of use, and preservation of user autonomy.

Summary of qualitative feedback

- The investment in application development must realize a greater return when compared to cheaper and more simplistic solutions.
- The concepts of high value impact analytics and business relevance are integrated and critical for successful deployment. If a proposed solution has no business relevance it will not be used and will soon become redundant.
- An application that is based on a deep understanding of the business and its decision processes will command a higher level of trust and will realize better outcomes. To achieve the required level of business understanding the analyst's role should be filled by someone with extensive operational experience.
- The solution must be integrated with the current ERP system, must not require any additional work, must be highly beneficial if extra effort is required, and reporting on its impact should be integrated with current reporting solutions. If the solution is not integrated it will simply not be used or at most it will be used but will be less effective.
- Although system transparency is important and creates trust it is more important that the system output is in line with user expectations or even gut feel.
- The use of an application will always be evaluated against simpler solutions. There must be a balance between ease of use and impact.
- Users must be allowed to override system output subject to a structured approval process.

Quantitative analysis
A summary of the quantitative analysis related to the definition and development of high value impact analytics applications is presented in Table 5.21 and Table 5.22.

	Effectiveness	**Correlation**	**Quadrant**
Defining the requirements for a high value impact advanced analytics application	87%	0.30	4

Table 5.21: Analysis of strategy section: Defining the requirements for a high value impact advanced analytics application

- The strategy was 87 percent effective in addressing the issues related to defining the requirements for a high value impact advanced analytics application.
- This section is located in quadrant four due to its strong effectiveness score and a correlation coefficient with the total that is lower than the median at 0.30.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
22	Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?	96%	0.19	4
23	Are you convinced that an in-depth understanding of the current and proposed decision processes is vitally important when developing analytics applications that are business relevant?	88%	0.21	4
24	Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?	67%	0.11	3
25	How convinced are that the advanced analytics application must be integrated with current business processes?	96%	0.19	4
26	How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?	88%	-0.02	4
27	Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?	75%	0.19	3
28	Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?	100%	0.00	4

Table 5.22: Analysis of related questions: Defining the requirements for a high value impact advanced analytics application

- Most questions for this section are located in the fourth quadrant which indicates that the strategy was effective in convincing the senior team that the main issues have been adequately addressed but that the questions were weakly correlated with the overall score.
- The strategy was not effective in convincing the senior team that the proposed decision analysis framework will provide the level of insight to an analyst that will allow him or her to develop business relevant analytics solutions.
- The team was also not convinced that the approach to achieving system transparency proposed in the strategy document will indeed deliver the required level of transparency.
- Overall the questions relating to this section were weakly correlated with the total score.

Discussion

- The senior team must know that the proposed analytics intervention will adhere to a set of standards that will ensure its effective application by the user base. What these standards are and how they will be applied is not of any real concern when it comes to making the decision to implement the advanced analytics strategy. It would be reasonable for the senior team to expect that these standards are in place.
- The senior team also understands that applications which include all the required standards may be more expensive. The trade off between increased cost and the effective use of the

application must be well motivated.

Recommendations

- The set of standards and principles on which the development of analytics applications are based is important in ensuring effectiveness and consistency.
- The standards and principles must be included as an addendum to the main strategy document.

5.7.5 Securing front line staff commitment

The approach followed in the initial advanced analytics strategy was that front line staff and management commitment requires training, incentive programs, effectively addressing employee fears and involving future users in the development of the decision optimization application.

Summary of qualitative feedback

- It is important to ensure commitment to the effective use of a particular analytics application. The most important driver of such commitment will be the value that is created by the application. Securing front line staff commitment is the only way that a strategy can be rolled out and applied.
- Regardless of how much project resources are allocated to ensuring front-line staff commitment the success of the project will be determined by its contribution to value, its ease of use and senior management support for the initiative. Project resource allocation will also change as the project progress. In the beginning most resources will be allocated towards application development and the resource allocation towards ensuring staff commitment will be quite small.
- Incentives should not be used to secure commitment. If the project creates value that is visible in business results then there will be commitment. Time and effort should be spent on explaining the reasons for the introduction of the application. Employees should not have the option not to use the application since using the application will be considered part of their job responsibilities.
- Training aimed at ensuring the effective use of the application is important since the better the user knows the application the more worth can be realized through its use. The only proviso is that the training itself should not take up too much of the employees time. Time spent on training is a function of the ease of use of the application. Higher complexity will require more training.

Quantitative analysis
A summary of the quantitative analysis related to securing front line staff commitment is presented in Table 5.23 and Table 5.24.

	Effectiveness	**Correlation**	**Quadrant**
Securing front line staff commitment	80%	0.84	2

Table 5.23: Analysis of strategy section: Securing front line staff commitment

- The strategy was only 80 percent effective in addressing this issue which is significant since this section is highly correlated with the total score with a correlation coefficient of 0.84.

- The low effectiveness of the strategy places this section firmly in the second quadrant.

Question Nr.	Question	Effectiveness	Correlation	Quadrant
30	Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?	100%	0.00	4
31	Are you convinced that at least 50% of project resources should be allocated to ensuring front line staff commitment?	75%	0.19	3
32	How convinced are you that specific incentive should be put in place to support commitment?	50%	0.32	3
33	Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?	96%	0.64	1

Table 5.24: Analysis of related questions: Securing front line staff commitment

- The senior team was not convinced (75 percent) that 50 percent of project resources should be allocated to ensuring user commitment.
- They were even less convinced (50 percent) that rewarding users with incentives was the way to go to ensure user commitment.
- These two items are weakly correlated with the total but the correlation coefficient of the section is so high that an effort should be made to improve the explanation related to these aspects of the strategy.
- The high level of effectiveness of the section is due to the high level at which the senior team is convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort and that this effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications.

Discussion

- User commitment is a function of high impact applications, senior management support, and effective training programs. It is not a function of incentive schemes or aggressive allocation of project resources to training programs.
- It is clear that the level of user commitment is closely related to a set of minimum required application standards such as business relevance, integration with current business processes, transparency in terms of application output, ease of use, and the preservation of user autonomy.
- Training programs are important but should not require an unrealistic investment in time by the potential user base. The time that it takes to train someone on a new application can be reduced by minimizing the complexity of the application. An effective training program will include a clear explanation of the business relevance of the application.

Recommendations

- The next version of the advanced analytics strategy should give a generic outline of training

programs which will include aspects such as business relevance, a message from senior management, application functionality training modules, and a high level explanation of the analytics model behind the application.

- It is important to establish what management's thinking is on the use of incentive schemes to ensure the required level of user commitment.

5.8 Advanced analytics strategy formulation: The second cycle strategy framework

Based on the analysis, discussion and recommendations in the preceding sections the next cycle strategy framework will have an expanded business case as the core section complemented by an extensive addendum.

5.8.1 Moving strategy sections to the addendum

A number of sections in the initial strategy were moved to the addendum based mainly on the strength of their correlation with the total score. The weaker correlated sections, when compared to the median correlation coefficient with the total of 0.42, included:

- Defining the requirements for a high value impact analytics application with a correlation coefficient with the total score of 0.30,
- Employing the required technical skills with a correlation coefficient with the total score of 0.19,
- Developing and managing quality data sources with a correlation coefficient with the total score of 0.19,
- Developing the required level of business insight with a correlation coefficient with the total score of 0.14, and
- Defining and implementing the enabling technologies with a correlation coefficient of 0.09 with the total score.

All of these sections are generic in nature and not specific to any particular business case. The qualitative feedback provided the motivation behind the relatively low correlation coefficients of these sections. When it comes to defining the requirements of high value impact analytics applications the question of what these requirements are and how they will be implemented is not of any real concern when it comes to making the decision to implement the advanced analytics strategy. It would be reasonable for the senior team to expect that these requirements are in place. Hence this section of the strategy section has a correlation coefficient with the total of 0.30.

The low correlation coefficient of the section dealing with the required technical skills is a consequence of the senior team's view on employing analytics professionals in the organization. Since the current view leans towards using external analytics resources the technical skills requirement of an internal analytics department is not of any major concern to the decision makers of the company at the moment.

The section of the strategy dealing with the development and management of quality data sources was not effective in contrasting a data centric approach to data management with an

application centric approach to data management. The advantages related to an application centric approach were not clearly presented.

Having business insight was regarded as a basic requirement for an analytics department to do any meaningful work. Having value management skills in the analytics department did not play a significant role in the decision to implement the strategy or not.

There are two reasons for the low correlation coefficient of the section dealing with the definition and implementation of the enabling technologies. In the first place the implementation of an analytics platform is only really important for the company if it has its own analytics department, an option that is not well supported by the senior team. Secondly, even if an analytics department is established, the choice of an analytics platform is a technical issue and will be made by individuals other than the members of the senior team.

5.8.2 Expanding the business case section

The section of the initial strategy related to the business case for a decision optimization project, had a correlation coefficient with the total of 0.64 which is much higher than the median of 0.42. The comprehensive qualitative feedback that was received on this section of the initial strategy combined with the high correlation with the total score, motivated the decision to make this part of the initial strategy the focal point for the next strategy framework.

The initial business case framework included the following sections:

- Assessment of the historical value creating ability of the business.
- Identification and prioritizing of value creating opportunities.
- Assessment of key underlying decision processes.
- The specification of high value impact analytics applications.
- Project team structure, main work streams and time frames.
- Quantification of the net value impact of the proposed interventions.

The historical value creating performance as well as prioritizing focus areas for value improvement provides an essential framework for guidance related to the type of analytics intervention that is required. In addition, the assessment of the underlying decision processes is the critical link between decision optimization and shareholder value creation. The first three elements namely, the assessment of the value creating ability of the business, the identification and prioritizing of value creating opportunities, and the assessment of key underlying decision processes were therefore retained and grouped under one main strategy section—the establishment of business focus and relevance.

The sections in the initial strategy that motivated for intrinsic value to be used as a quality measure of the impact of an analytics initiative as well as the explanation of the causal link between decision optimization and shareholder value creation were treated as separate sections. In the second cycle strategy these sections will be condensed and included in the introduction of the section dealing with the establishment of business focus and relevance.

The subsection in the initial business case that dealt with the specification of high value impact analytics as well as the subsection that dealt with the quantification of the net value impact of the proposed interventions, were unconvincing. The respondents found it difficult to understand the concept of an application that can optimize a decision process in a business. Although detailed descriptions of concept decision optimization models were presented, most respondents

remained unclear as to how these would be used on a day to day basis. The only possible way to solve this would be to develop working concept applications that are fully functional but limited in scope. The next version of the strategy therefore includes a main section that is dedicated to the development and testing of concept applications.

The results from the survey also indicated that it is important to convince the senior team that all aspects related to the implementation of the proposed decision optimization applications have been considered. These include the structure of the project team, an overview of the main work streams and their associated time frames. Also included in this section is the issue of securing front line staff support. It is included here since training is the primary component of securing staff support and training is logically part of system implementation. Both the establishing of an analytics culture and incorporating the analytical focus in the organizational structure have staffing and training implications and these sections of the initial strategy are therefore included as part of system implementation.

These changes resulted in an improved analytics strategy framework that is more aligned with management's thinking on advanced analytics. These improvements will dramatically increase the probability of implementing an advanced analytics strategy that incorporates the practical business requirements and limitations of the holding company.

5.8.3 The three main steps of the second cycle strategy framework

The strategy process can be divided into three main steps:

- Establishing business focus and relevance,
- Developing and testing concept applications, and
- Moving selected applications into production.

Establishing business focus and relevance

The process of establishing relevance and focus starts with analyzing the historical value creating ability of the business. The analysis of the historical value creating ability is based on a trend analysis of key value drivers such as return on invested capital, revenue growth, and the credit health of the business. The outcome from this analysis will determine if the focus should be on improving the company's return on invested capital, its revenue growth, or its financial risk profile or a combination of these. The choice is based on the understanding that it is only beneficial for a company to increase its growth rate if its return on invested capital is higher than its cost of capital. If this is not the case increased growth rates just accelerates value destruction.

The next step would be to identify the specific value drivers whose improvement can have the most beneficial impact on the value of the business. The sensitivity of intrinsic value to particular value drivers is a function of the company's capital intensity and cost structures. These value drivers must be identified at such a level to allow for the isolation of decision processes that determine their current and future levels.

Finally, the underlying decision processes are analyzed and potential areas for process improvement are identified. Complex, high frequency decisions are good candidates for decision optimization using automation delivered through an integrated decision optimization application.

Developing and testing concept applications

The next step would be to develop concept applications that will include the analytics models, data access and the user interface. The only real difference between a concept application and an operational application is scope. The concept application will operate on a subset of the data or on a specific part of the business, such as a particular branch, distribution center or customer.

The concept applications are tested using historical data as input to determine their ability to realize improvements when compared to the current decision processes in the company. These improvements must be expressed in terms their impact on key value drivers.

The concept models are then ranked based on the potential improvement in intrinsic value that each can realize. The aim here is to present an application development pipeline to the decision makers using value impact as a rank variable.

A particular application may also present the potential for creating a sustainable competitive advantage for the company. The potential value impact and the potential for creating a sustainable competitive advantage are used to select concept application that will be moved into a production.

Moving selected applications into production

The section of the strategy document that deals with application development and implementation starts with a detailed project plan. The main work streams related to model development, data access and user interface functionality must be presented with their corresponding time frames. The discussion of the project team must include a clear description of responsibilities of the team members.

The project plan detailing the application roll out and training must be presented. This plan will include a roll out and training schedule and clearly identify the individuals or groups of individuals that will be involved in both. The development of the training program is an important work stream. The strategy document should include an overview of all aspects that will be addressed in the training material including the message from company leadership, an overview of the business relevance, a section on addressing fears and highlighting opportunities and the various modules on application functionality.

The final aspect of implementation that needs to be addressed is the potential organizational changes that are directly related to the project. This section of the strategy will include motivations for adding new roles or retraining current roles with associated costs.

Models, methods and frameworks

The strategy development process is informed by a number of different models, methods and frameworks. The most important model is a detailed valuation model of the company. The valuation model is used at different stages of the strategy development process. It is used to analyze the historical value creating ability of the business, it is used to rank variables in terms of their contribution to shareholder value creation using sensitivity analysis, and it is used to determine the value impact of improvements that may result from the implementation of a decision optimization application. The model must therefore be robust in terms of its ability to reflect the complex interactions of key value drivers and it must be detailed enough to allow for the identification of those aspects of the business that contribute most to its ability to create

shareholder value. An overview of the valuation model and the assumptions on which it was based must be presented in an addendum to the main strategy document.

The decision analysis framework is another important tool in the strategy development tool set. Following a prescribed framework allows for the proper assessment and identification of opportunities for improvement. A description of the decision analysis framework may be included in an addendum to the main strategy document.

The principles on which the development of the concept and final applications are based may be listed and defined in an addendum. These are:

- Application centric versus data centric approach to data management,
- Relevance in terms of business focus and impact,
- Integration with current business processes,
- Transparency in terms of methods and results,
- Ease of use, and
- Preservation of user autonomy.

The new roles and training requirements that are identified in the strategy is based on a skills development framework that clearly indicate the current availability of skills compared to the required type and level of skills needed to effectively implement the proposed analytics interventions. The skills development framework will cover aspects such as:

- The required organizational changes that will allow for the effective incorporation of the focus on analytics in the company,
- The structure of an effective analytics department,
- The establishment of an analytics culture,
- The employment or development of the required level of business insight in the analytics department, and
- The employment or development of the required technical skills to effectively support decision optimization.

The back testing model will be used to test the functionality and impact of decision optimization applications using historical, transactional level data. The framework for the assessment of analytics platform vendors is an important tool for identifying a short list of vendors that can effectively support an analytics initiative.

5.9 Conclusion

The second cycle strategy framework is shown in Figure 5.2. The framework consists of the main strategy development process, the main sections of the strategy and the models, methods and frameworks on which the strategy is based.

The second cycle strategy framework represents the final output of the research process related to this thesis. The framework will be used to develop the strategy document that will be presented to the senior management team in the second cycle strategy evaluation process. Due to time and resource constraints the current thesis will not include the development of the second cycle strategy document.

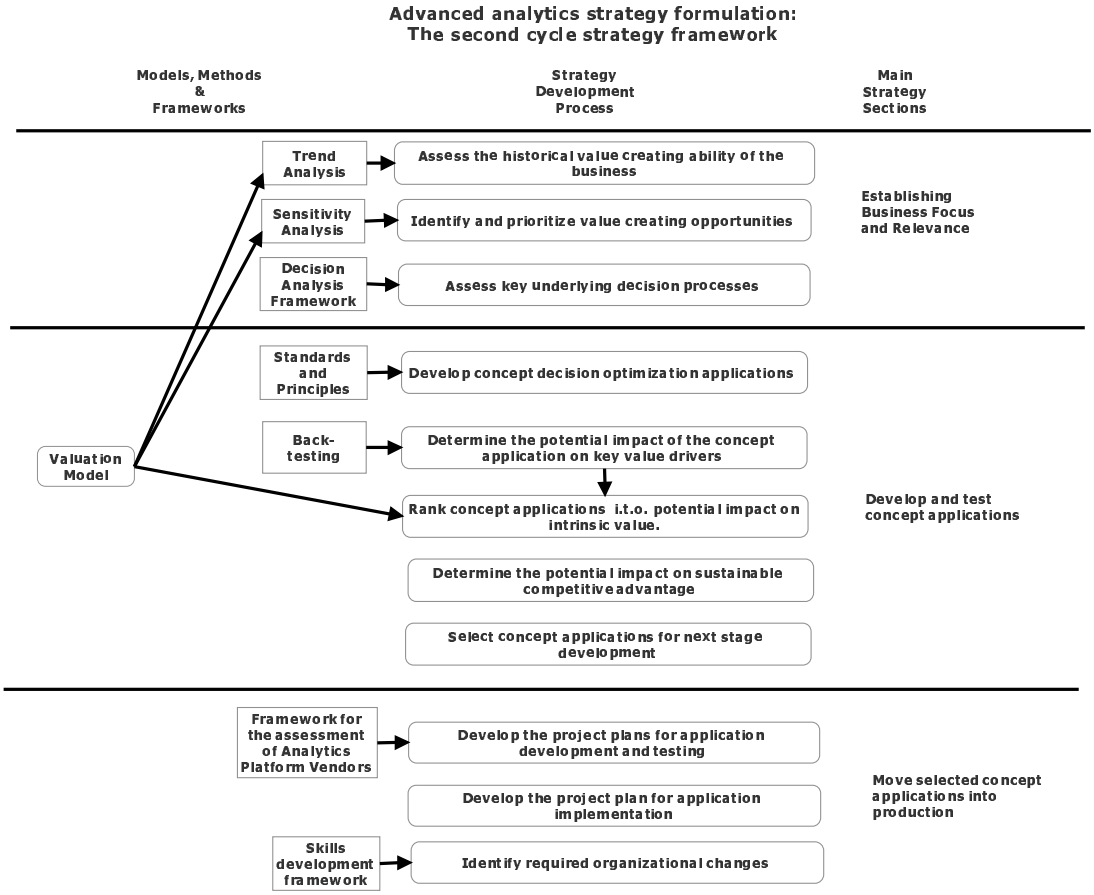

Figure 5.2: Advanced analytics strategy formulation: The second cycle strategy framework

CHAPTER 6

Conclusions

Contents

6.1 An overview of the research process

The primary objective of this thesis was to establish an approach for the development of an advanced analytics strategy for a company. This was a challenging undertaking due to the absence of well described examples or published research on the subject. It was therefore necessary to generate insight and knowledge using a research approach that allowed for the development, testing, and improvement of a proposed solution over multiple cycles. Such a research approach presented itself in the form of the action research process.

The research process started with an extensive literature survey that was aimed at gaining a better understanding of the challenges facing companies when implementing advanced analytics projects. The findings from the literature survey were also used to develop a general framework on which an analytics strategy could be based. The approaches proposed by various authors in dealing with the issues that restrict the application and strategic integration of advanced analytics, were used to develop the detail around the framework and create the initial version of the advanced analytics strategy. The strategy also included a business case for a decision optimization project for one of the subsidiaries of the holding company.

This first pass at an advanced analytics strategy needed to be tested. Questions related to each section in the strategy document were formulated to test the effectiveness of the strategy in dealing with the issues that restrict the application and strategic integration of advanced analytics within the context of the researched business. Each question consisted of a rating section as well as a follow up question to solicit an unstructured response. The questions were integrated with the strategy document and presented to a group of senior decision makers in the researched company as strategy evaluation documents. The respondents had little previous exposure to analytics which allowed them to assess the strategy from a business perspective.

Seven strategy evaluation documents were distributed of which six completed documents were

received back. This is good response rate taking into consideration that on average the respondents spent between three and four hours to complete the evaluation.

The responses were captured and analyzed. The qualitative feedback, which included notes made on the document and comments made during the debriefing sessions with the respondents, were summarized in point form. The quantitative data, that were based on the enumeration of responses in the rating scale section of the question, were analyzed along two dimensions namely effectiveness and correlation with the total score. Effectiveness measured the degree to which the respondents were convinced that the approach suggested in the strategy to dealing with a particular issue would be effective within the researched business.

The quantitative and qualitative results from the survey were used to inform a set of recommended changes to the initial strategy. The changes included aspects that needed to be excluded since their impact on the final decision were insignificant, refinement of methods that were used to inform the first strategy, recasting of sections to more clearly express ideas, changed approaches to addressing some issues, and finally, changes to the document structure to improve its logical flow.

6.2 The value of the research process

The research process created structure around the problem of limited application and integration of advanced analytics.

The use of valuation modeling to determine business relevance and focus led to the creation of advanced analytics strategies that are aligned with a central business objective, namely shareholder value creation.

The research resulted in the development of a measurement mechanism which was used to measure the progress of strategy development in terms of strategy quality and alignment. The ability to measure the impact of changes to the strategy created a practical platform for continuous improvement.

The research process allowed for a wide range of concepts and ideas related to advanced analytics to be tested within a practical business environment.

6.3 Insights gained from the research

Some of the key insights that were gained during the research process are listed below:

- The conversations on advanced analytics were business conversations. They focused on the financial performance of the business and potential areas of improvement. Pro-active identification of these focus areas, even if it was on a relatively broad level, created a platform from which future conversations were launched.
- The respondents found it difficult to understand the concept of an application that can optimize a decision process in a business. Although detailed descriptions of concept decision optimization models were presented in the strategy evaluation document, most respondents remained unclear as to how these would be used on a day to day basis. Because of this the idea of creating a sustainable competitive advantage based on an advanced analytics application was not clearly understood. The only possible way to solve this would be to develop working concept applications that are fully functional but limited in scope.

- Due to a general unfamiliarity with advanced analytics the standard against which these projects will be measured are much more stringent than for example management consulting proposals. If the analytics project will not directly improve the financial position of the company in a substantial way the project will not be approved. The impact must be tangible, measurable and significant.
- Although the respondents accepted the idea that there is a causal relationship between an analytics intervention and intrinsic value and that intrinsic value is a strong predictor of changes in shareholder value, they preferred to measure the impact using less complicated measures such as changes in operating profit and changes in working capital.
- Organizational changes should be introduced gradually and in line with measurable returns. There was not much consensus on the best organizational structure. The centralized, well-staffed analytics department suggested in the analytics literature was not an option. The initial couple of projects would have to be staffed using external resources. Only when these projects realize tangible, measurable and significant returns may the appointment or training of additional resources be considered.
- The senior management team in this company agreed that data and the correct mix of technical skills are important but they were not interested in the details related to data management, talent acquisition, and talent management. The senior team accepted that these aspects of an analytics initiative would be in place.
- The respondents were divided on the appointment and reporting relationship of a senior manager responsible for analytics. Half of the respondents preferred not to appoint a senior manager and if an appointment had to be made this individual must report to the group financial director. The other half supported the appointment of a senior manager reporting directly to the group managing director.
- The senior decision makers came out strong against an incentive scheme that pays individuals for their use of a particular decision optimization application. They prefer that the business relevance and integration of an application be of such a level that the users will be compelled to use it without coercing using special incentives.

These insights can be used as general guidelines when developing an advanced analytics strategy for a company. It must be remembered that the insights are based on the feedback obtained from the senior management team of one company.

6.4 Potential research topics

There are a number of potential research topics that may flow from the current research.

- Research aimed at refining the structure used in this thesis will contribute much to the definition and understanding of the problem. A robust structure will allow for the effective categorization of future research and discussion on potential approaches to dealing with the issues that restrict application and integration of advanced analytics.
- The second topic relates to the measurement of the effectiveness of an advanced analytics strategy and the prioritizing of those sections of a proposed strategy that requires improvement. The format of the measurement instrument, the variables that are being measured, and the selection of respondents can be refined and compared to those used in this thesis.
- A third potential research topic relates to the exploration of the action research process as a platform for strategy development in general. The iterative nature of the action research

process leads to continuous improvement and continuous measurement of a strategy's effectiveness.

- Using the action research approach the second cycle strategy framework as proposed in this thesis, must be refined. This strategy framework can, through its application and refinement, contribute directly to increasing the number of companies that effectively apply advanced analytics and as a result play an integral role in expanding the potential market for the services of practitioners and advanced analytics software vendors alike.

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APPENDIX A

Initial advanced analytics strategy

Contents

A.1 Strategy objective

The objective of the strategy is to define precisely how the Holding Company can, through the effective application of advanced analytics, increase shareholder value of one of its subsidiaries by between R30 million and R50 million. The strategy will also detail how the company can create a sustainable competitive advantage that will allow it to increase the shareholder value of the whole group.

Advanced analytics consist of advanced prescriptive, predictive, and descriptive modeling techniques that are used to transform data into actions in the context of organizational decision making. Prescriptive modeling refers to a portfolio of techniques that prescribes the best possible action that can be taken, given a particular set of alternatives. Predictive modeling attempts to determine the probability of some future event occurring. Descriptive analytics is a combination of statistical techniques that are used to formulate a better understanding of the past.

A.2 Creating a sustainable competitive advantage

This strategy will detail how the Holding Company will create a sustainable competitive advantage by developing the capability to optimize key decision processes across all businesses in the group. This capability will be based on advanced analytics applications that will be developed and implemented by a newly created analytics department.

The advanced analytics applications represent resources that are valuable, rare, inimitable, and non-substitutable. Resources are valuable if they allow a company to realize improvements in efficiency and effectiveness if leveraged. They are rare if they are only held by the particular company or if they are difficult to source. Resources are inimitable if they cannot be replicated due to their uniqueness and a resource is non-substitutable if the same outcome cannot be replicated from the application of a direct equivalent.

Having such resources allow a company to more successfully create sustainable competitive advantages.

A.3 Defining the potential value impact

If we assume that the primary objective of the company is sustainable shareholder value creation, then the direct impact of an analytics initiative should be measured in terms of its potential improvement of the intrinsic value of the company. This is because the intrinsic value of a company is a strong predictor of its market value and therefore shareholder value.

Intrinsic value is defined as the sum of the book value of the company's operating assets and the present value of its annual future economic profit. The market value of the business consists of the value of its debt plus the value of its equity as determined by the market price for its ordinary shares. In an efficient market the market value will be equal to the intrinsic value. In reality these two measures are not always correlated. A consistently large deviation of the company's market value from its intrinsic value is however rare with deviations normally restricted within a band of twenty percent more or less than intrinsic value.

There are a number of factors that can determine how accurately the company's shares are priced in relation to its intrinsic value. These include low transactional volume, trading restrictions that prohibit arbitrage and the company's investor profile. If the investor profile has a large

enough proportion of shares held by intrinsic investors, the market price tends to track the intrinsic value more closely. In contrast, noise-traders tend to over- or under-estimate the value of a share, contributing to pricing deviations and volatility. The impact of the investor profile on pricing is exactly the reason why alignment between market value and intrinsic value can be significantly strengthened through effective investor communications.

A.4 Defining the causal relationship between the application of advanced analytics and an increase in shareholder value

We have shown that intrinsic value is a strong predictor of market value. If we are therefore able to increase the intrinsic value of the business, an increase in the market value of ordinary shares and consequently an increase in shareholder value are sure to follow.

We increase intrinsic value by strengthening the company's ability to generate future economic profit. We do this by increasing the return that the company can generate on its invested capital ($ROIC$) and by reducing the cost of financing measured in terms of the weighted average cost of capital or $WACC$. This will result in an increase in the spread between the return on capital on the one hand and the cost of capital on the other, and will lead to an increase in economic profit as shown in the following formula:

$$Economic\ Profit = (ROIC\% - WACC\%) \times (Book\ Value\ of\ OperatingAssets).$$

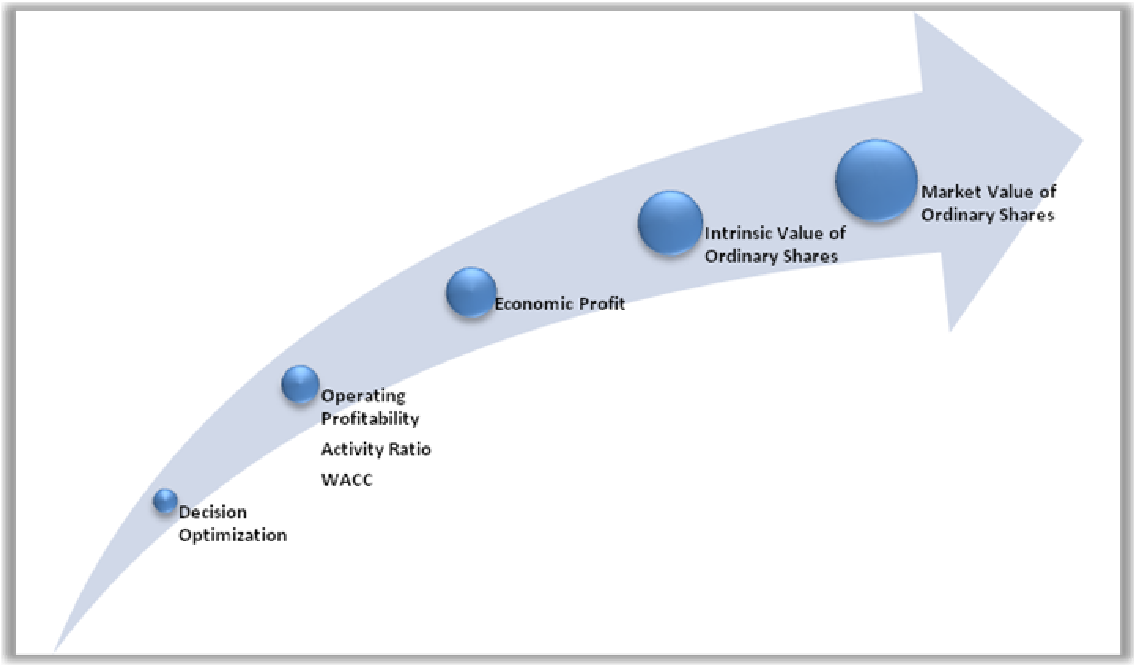
Here $ROIC\%$ is the operating profit expressed as a percentage of the company's operating assets ($ROIC$ x 100/Operating Assets), $WACC\%$ is the weighted average cost of debt and equity expressed as a percentage, and the difference between the two is referred to as the spread between the return on capital and the cost of capital.

It follows from the definition of $ROIC\%$ that the company's return on capital can be improved by increasing its operating profit or decreasing its operating asset base. Since both are related to revenue it is important that any improvements in operating profit and asset efficiency be assessed in relation to expected revenue performance. To measure and improve the efficiency of the company's cost structure as well as the productivity of its assets, it is therefore more instructive to focus on operating profit as a percentage of sales and to focus on the activity ratio which is the ratio of revenue to operating assets (Revenue/Operating Assets).

The quality of operating and strategic decisions determines the company's performance in terms of asset productivity, cost structure efficiency, and risk management and is measured in terms of its operating profit, activity, and $WACC$. Advanced analytics are used to optimize these decisions resulting in a direct and significant improvement in the company's operating profit, activity and $WACC$ and therefore its ability to generate economic profit.

We focus our efforts specifically on decision optimization since the quality and consistency of decision processes that are based on intuition is compromised in complex or high volume decision making environments. This is due to a high prevalence of decision bias and natural limitations on the number of alternatives that can be considered without technological help.

The impact of moving from this obviously sub-optimal decision making environment to decision optimality can be significant especially when focusing the optimization efforts on those areas of the business that contribute most to the value creating ability of the company.



A.5 Developing the required analytics capabilities

In order to develop the analytics capabilities that are required to deliver high value impact analytics applications that are focused on decision optimization, the Holding Company will have to:

- Incorporate the analytics focus in its organizational structure,
- Establish an analytics culture in the organization,
- Develop and employ the required business insight,
- Develop and employ the required technical skill set, and
- Define and implement the enabling technology platform.

A.5.1 Incorporating the analytics focus in the organizational structure

The realization of an analytics-based competitive advantage will require changes to the organizational structure of the Holding Company. An organizational structure that effectively support the implementation and continued application of analytics will have to be created and staffed.

To start, it is important to define the position of an analytics department in relation to the rest of the organization. Centralization represents the most progressive approach to the positioning of an analytics department within a business. In the centralized model the analytics department will leverage its competencies across all aspects of the business with its primary focus determined by strategic imperatives. The analytics department will catalyze analytics efforts, working closely with the business to rapidly develop and deploy analytics-based solutions.

The centralized model may however require a larger department size with a comprehensive set of roles and responsibilities. The main job categories include operations research and management science, data science, financial modeling, statistical modeling, and application development.

Heading up the analytics department is the Analytics Department Manager (ADM). ADMs usually play a bigger role in management and mentoring than in modeling. In addition to a strong numerical background, the department manager must be able to develop and implement a long-range project plan for business value creation. The ADM must therefore ensure that the analytics-based strategic plan is implemented. This individual must maintain a high level of staff retention and continuously grow the skill set offered by the analytics department.

In addition to the ADM a senior management resource may be required. The development of a detailed analytics strategy will be the most important focus area for this individual. Capturing the benefits of analytics requires a clear plan with established priorities and a clearly defined path to the achievement of business results. Developing such a plan requires leadership and dedicated effort.

In addition, the senior manager will have to make critical investment decisions. The resource demands of an analytics project can be considerable. It is important that the correct decisions are made in terms of buying core software or developing the applications in house.

Senior managers that are able to forge high level data partnerships with customers, suppliers, or other players along the value chain can lock in access to valuable external data sources.

The senior manager will also have to ensure that the analytics skill set of the company is aligned with it long-term analytics strategy. The senior manager will be required to engage a growing number of deep analytics experts. These are the individuals that will realize the value of the data through the deployment of the predictive and optimization models that they build.

The amount of management effort that are required to mobilize the human and capital resources across various functions in order to deliver decision optimization tools that will help front line managers make optimal decisions, can be substantial. The effort will be focused on getting a diverse group of managers to work together across IT, analytics, training, and business line boundaries. It should be obvious that the probability of failure is high without senior management commitment and involvement.

A.5.2 Establishing an analytics culture

The senior manager will also be responsible for promoting an analytics culture throughout the organization. Establishing an analytics culture requires commitment at senior management level based on trust and a clear understanding of the strategic and operational opportunities that can be realized through the application of advanced analytics.

The senior management team need to embrace the idea that data is a core part of their business. They need to know what is feasible in terms of data-based decision making. It is only when that top perspective is properly in place that durable behavioral changes can be radiated throughout the organization.

What is needed is a senior manager that can apply institutional knowledge, work through obstacles, make tough trade-offs, effectively resolve points of decision conflict and in general signal that senior management is serious and committed to the analytics initiative.

A.5.3 Developing and employing the required level of business insight

To achieve strategic alignment will require the analytics department to demonstrate a significant level of business insight and understanding. More importantly, having in-depth knowledge of the business has a direct impact on the perceived and actual relevance of analytics.

The level of business understanding and insight of an analytics department can be dramatically strengthened through the development and acquisition of advanced financial modeling skills with specific focus on company valuation modeling.

In order to perform a quality valuation of the business the financial modeling analyst must have a very clear understanding of financial accounting and financial management theory. The enumeration of the key value drivers and their impact on the intrinsic value of the business represent the critical link between decision optimization and shareholder value creation. The quality of this link is directly related the skills and abilities of the financial modeling analyst.

For the senior manager to act as a translator between business and analytics, a deep understanding of value management and valuation modeling will provide the business insight that is required. The valuation exercise will force the manager to assess the business from an investor's perspective and gain a better understanding of how the market will value the potential impact of analytics on revenue growth, margin increases or improvements in capital efficiency. This approach will allow the senior manager to further advance the understanding of senior management team on the role of analytics in shareholder value creation.

A.5.4 Developing and employing the required technical skill set

Having the right analytical skills in the organization is critical to the successful deployment of analytics. Selecting the analytical approach that will be most applicable to a particular situation is however, rarely restricted to one type or even one group of methodologies. In most cases it is a combination of methodologies that delivers the best impact. It is therefore important that the analytics department have a clear understanding of a broad range of analytics methodologies.

A company that is focused on decision optimization must employ optimization skills. An analyst that specializes in descriptive and predictive analytics but with little or no training in prescriptive analytics will not have the skill set to optimize decisions. The company will however, find well honed optimization skills in operations researchers, management scientists, and industrial engineers and should employ these individuals as part of the core analytics team. Predictive analytical skills can be hired in when needed.

Finally, advanced application development skills is a critical component of the skill set of a high impact analytics department.

A.5.5 Defining and implementing the enabling technology platform

Choosing the right technology platform for the implementation of the advanced analytics initiative is integral to its successful deployment and application. Analytics is a data intensive process and requires sophisticated technology to properly analyze the data and deploy solutions.

Analytical assets such as decision optimization applications are developed on an analytical platform. This analytical platform is a combination of tools that are used to create analytical assets and store and manage data. Such a platform would for example include data management tools, optimization tools, and statistical analysis tools, all using a single interface or programming language, allowing for the development of fully integrated analytics applications.

When deciding on a particular analytical platform we start with an assessment of the level of sophistication or maturity of the current analytical platform in the organization, determine what is required, and identify the technology gap that needs to be filled.

In terms of analytics solutions, the IT department in the Holding Company currently provides the agriculture business in the group with business intelligence services that are mainly focused on fixed format as well as ad hoc reporting. In order to bridge the gap between the current and required level of analytics maturity the following actions will have to be taken:

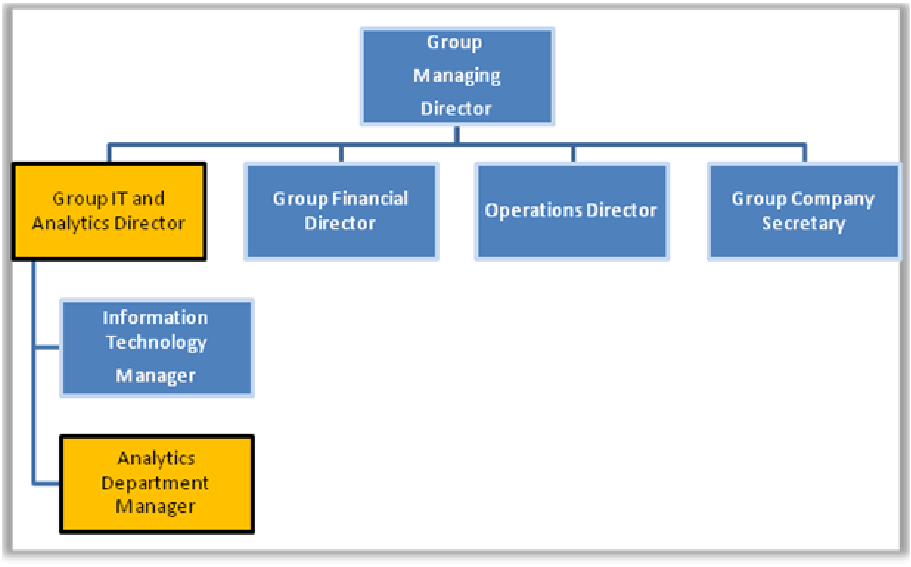
- The Holding Company will have to standardize on an advance analytical platform that allows for effective data integration and includes a wide range of analytical tools that support statistical analysis, forecasting, simulation and optimization.
- The analytical platform must support the integration of different sources and formats of data.
- The analytical platform must integrate with a wide range of ERP platforms to allow for the integration of analytics applications with current transactional systems in the group.

The first step would be to invite vendors that supply analytical platforms to quote on the implementation of an analytical platform at the Holding Company. The vendor invitation will be based on the fit between the functionality requirements based on the Holding Company's future decision optimization strategies and the functionality provided by the vendor's advanced analytical platform. Other aspects that will be considered include the vendor's ability to implement and support the software as well as its future research and development focus and intensity.

The costs associated with the implementation of an analytical platform for the Holding Company is estimated to be R2,500,000 plus an additional annual licensing fee of approximately R200,000.

A.5.6 Proposed organizational structure and cost implications

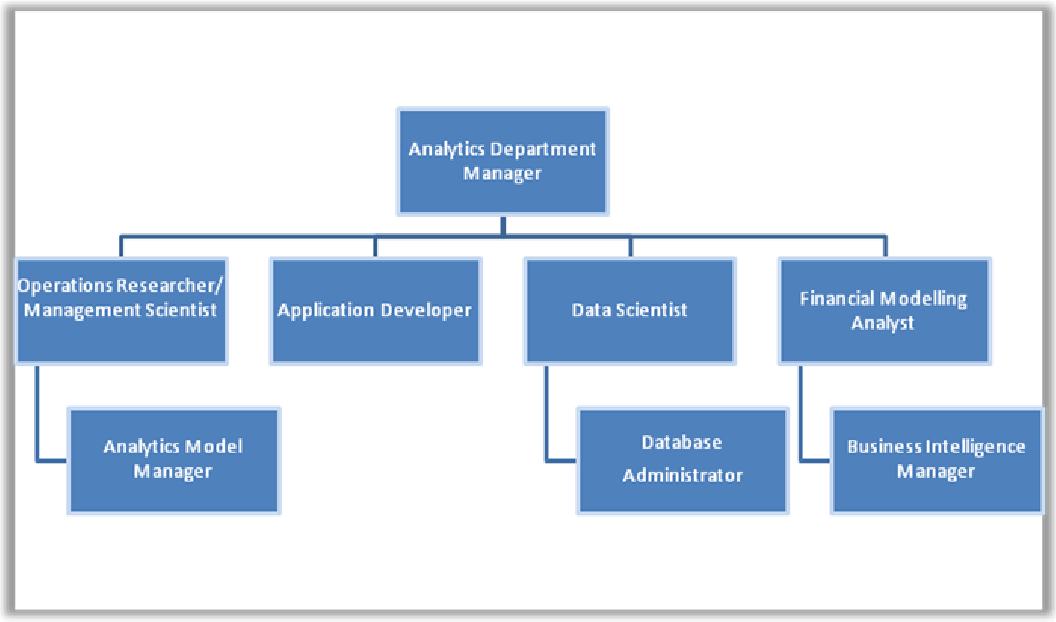
We would recommend that the company first appoint a Group IT and Analytics Director who will initially be tasked with strategy formulation and the establishment of the analytics department in the organization. The Group IT and Analytics Director will report directly to the Group Managing Director. This individual will take responsibility for both the analytics as well as the IT department in the company with both the IT Manager as well as the Analytics Department Manager, reporting into him/her.



The key responsibilities of the Group IT and Analytics Director will be:

- The development of a detailed long-term analytics strategy aimed at realizing tangible business value and the creation of a sustainable competitive advantage.
- To ensure that investments in IT infrastructure and personnel are aligned with the long-term business strategy of the Holding Company.
- To make key analytics resource investments.
- To forge high level data partnerships with various parties in the value chain.
- To mobilize human and capital resources in order to deliver high value impact analytics interventions.
- To ensure effective application of high impact interventions.
- To communicate the planned and realized value impact of advanced analytics initiatives to senior management and intrinsic investors.
- To promote an analytics culture throughout the organization.

The proposed analytics department will include the following positions:



The key responsibilities of the analytics department manager will be to:

- Work closely with the Group IT and Analytics Director in the development and implementation of the strategic plan.
- Develop an analytics department that can effectively deploy descriptive, predictive and prescriptive models.
- Ensure high levels of performance and staff retention.
- Develop processes related to model development, testing, deployment and maintenance.
- Provide technical support to the Group IT and Analytics Director.
- Work as the main interface between IT and Analytics.

The Cost to Company estimates for the proposed new positions are as follows:

Position	**Cost to Company**
Group IT and Analytics Director	R1,300,000
Analytics Department Manager	R990,000
OR/MS Manager	R900,000
Data Scientist	R800,000
Financial Modeling Analyst	R800,000
Analytics Model Manager	R330,000
Database Administrator	R330,000
Total	**R5,450,000**

A.6 General principles related to the development and deployment of advanced analytics solutions

There are a number of principles that govern the successful implementation of an advanced analytics initiative such as this one. These principles relate to data management, application development, and front line staff commitment and should be adhered to as far as possible.

A.6.1 Developing and managing quality data sources

Quality data is critical to optimization modeling and during the modeling process a significant portion of time and resources are dedicated towards working with data. This is because data populates the logical structures of an optimization model and makes it relevant to the decision at hand.

More generally, it would be fair to say that a lack of data quality, integrity and consistency is one of the main barriers that prevents the effective adoption and use of analytics in organizations.

Companies tend to focus most of their analytical effort on data acquisition, cleansing and integration. In many cases however, companies already have the data that they need to make more effective decisions. Our approach to data starts with the problems that we wish to solve or the opportunities that we would like to exploit. This allows us to do a comprehensive but focused assessment of the available information sources.

The type of decisions that need improvement as well as the data and analysis that will realize such an improvement will influence other decisions relating to the implementation of advanced analytics. These included decisions relating to the structure of the data, acceptable levels of data accuracy and whether to purchase off the shelve data management software or develop proprietary data management systems.

A.6.2 Developing and implementing advanced analytics applications

Our focus is on the deployment of specific analytics applications as appose to the more general concept of deploying analytics. This will allow the business to gain a clear understanding of how analytics can improve performance.

The main challenge lies in getting managers and front line personnel to use new tools purposefully and enthusiastically. Part of the solution lies in the development of “killer applications” that

combine smart intuitive design and robust functionality. It is of utmost importance to invest enough time and resources in the development of these applications.

For an analytics application to be regarded as a "killer application" it must meet the following requirements:

- It must be highly relevant in terms of business focus and impact,
- It must be integrated with current business processes,
- It must be transparent in terms of its methods and results,
- It must be easy to use, and
- It must preserve user autonomy.

Business relevance

The implementation of analytics initiatives may fail simply because it is not in sync with the day-to-day processes and decision making norms of the business. In other words, the analytics application lacks business relevance.

The company will also fail to generate value from analytics if data-driven insights are not turned into action on the front line.

Business relevance can be realized by ensuring that:

- The analytics initiative is based on a clear blueprint for realizing shareholder value,
- The analysis and insight that are generated are integrated into the daily decision making processes of managers and front line staff,
- The process changes are clearly defined and easy to understand,
- The software tools are intuitive and scalable,
- An in depth understanding of the current and proposed decision processes is established.

In order to gain a clear understanding, the current and proposed decision processes are analyzed along the following dimensions:

- The key decisions that are being made,
- The determinants of decision complexity,
- The elements of complexity that can be included in the model,
- The elements of decision complexity that may be ignored,
- The factors that distinguishes a practical decision from an impractical one, and
- The way in which the output of the model will be applied.

Integration

In addition to business relevance the analytics application must ideally be fully integrated into the decision process that it aims to optimize. A well integrate solution reduces training requirements and increases user adoption and usage.

The deployment of a solution within a decision process requires a very clear understanding of the decision process and the analytics solution. We therefore clearly define the point in the decision process when the analytics application will be triggered, what information needs to be passed to the application, and what information will be passed back to the decision process. The actions that need to taken based on the information that is passed back to the decision process are clearly specified.

Transparency

It is important to show the users of an analytics application how the results are calculated, how business rules are used and how optimal decisions are identified and formulated. A detailed understanding is not required but a clear explanation of the logic underlying the outcome of the application is absolutely critical. This level of application transparency is realized by:

- Avoiding black box solutions,
- Developing and testing prototypes with the intended user population,
- Effectively dealing with potentially incorrect model output, and
- Properly verifying and validating the application and its underlying analytical model.

Ease of use

Analytical tools are notoriously difficult to use by non-experts. These tools seem to have been designed for analytics experts rather than people on the front lines of the business. The reality is that if managers and front line staff do not find the analytics applications engaging enough, these tools will not be used.

The answer lies in embedding the complex analytics in easy to use front line tools. Managers and employees need easy to understand ways of interacting with Tera bytes of data and sophisticated modeling that underlies decision optimization.

The proposed applications will be created with intuitive user interfaces which will in turn, support rapid deployment with very little training.

User autonomy

Analytics applications that prescribe an optimal decision must do so while preserving user autonomy. The applications make base-case recommendations that decision makers will then use to inform their thinking. A decision maker can accept a recommendation or adjust it to take into consideration aspects of the decision situation that are not included in the model. The preservation of human judgment will increase the level of acceptance and use of the proposed applications.

All of the applications that have been proposed in this strategy allow decision makers to apply their own judgment and experience to the output of the application.

A.6.3 Getting front line staff commitment

The required level of adoption of analytics applications is realized through effective training, on the job coaching, and metrics that clearly define and measure success. The level of effort focused on ensuring front line adoption is very important. In most cases, ninety percent of a company's investment in analytics is directed at application development. We propose that this should be more towards fifty percent with the other fifty being allocated to ensuring application adoption and usage.

Individuals who will be using analytics applications do not necessarily have to understand the technical detail of the applications. They do however need to know why, when and how to use the applications. This implies that everyone who will be interacting with the applications must have a clear understanding of the objectives of the applications as well as what constitutes effective performance. It is important to ensure that the right combination of incentives and negative consequences are in place to reinforce the intended behavior.

It is also important to effectively address any employee fears that may be associated with the implementation of the suggested applications. We accept that the introduction of new technology can cause increased workplace stress, a fear of job loss, and a deterioration of employees' self worth. To allay these fears in the short-term we will position the applications as job aids and over the long-term as potential career advancers. Decision optimization applications can easily be positioned as both. They represent tools that can improve employees' decision making performance to levels that was previously not thought possible.

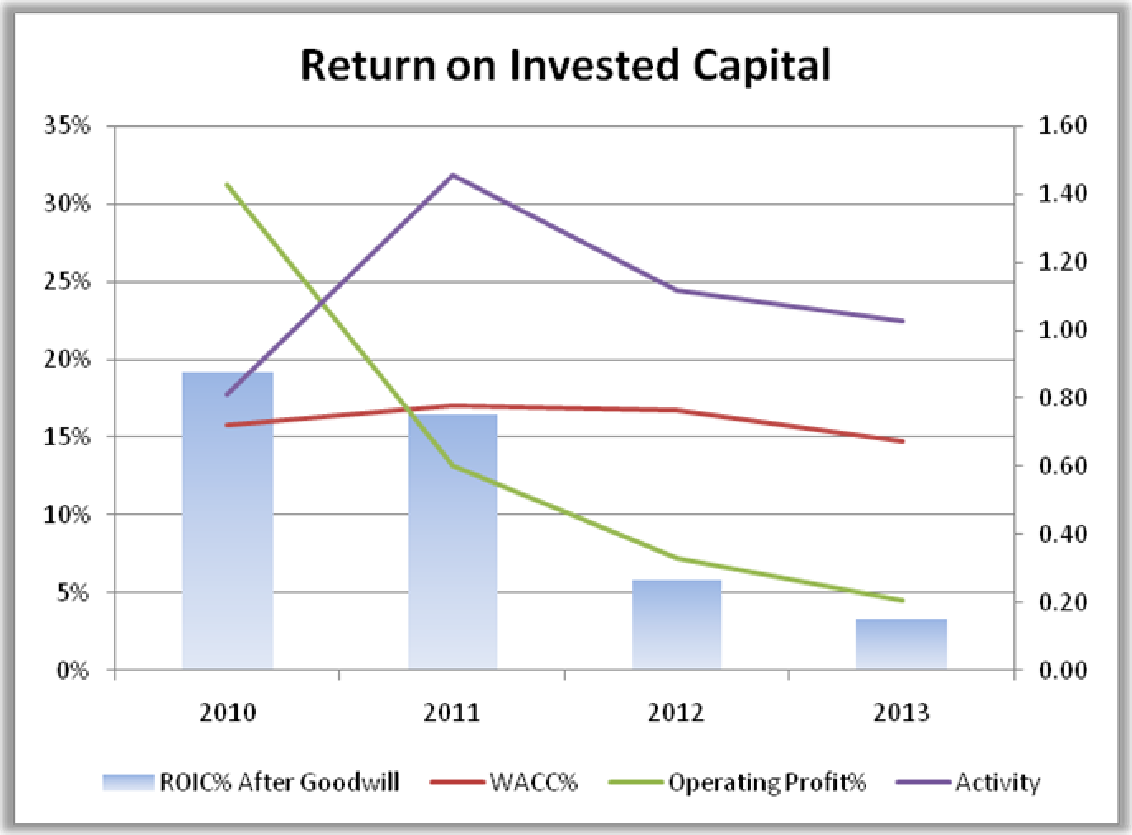
A.7 The subsidiary company decision optimization project

The Subsidiary Company was established in 1983 and acquired by the Holding Company on 1 November 2007. The company specializes in the importation, distribution and marketing of industrial fasteners. The company has branches throughout South Africa. These branches are located in Cape Town (Epping and Montegue Gardens), Port Elizabeth, Durban, Johannesburg, Pretoria, and Saldanha. With close to 35,000 different stock items, the Subsidiary Company is one of the largest suppliers of steel fasteners in South Africa. The company supplies businesses in the mining-, construction-, manufacturing- and maritime-sectors.

A.7.1 Historical value creating performance

It is important to get an understanding of the Subsidiary Company's historical value creating performance since that will direct any potential intervention to focus either on growth or efficiency improvements. Growth initiatives only make sense if the company's return on invested capital is greater than the cost of capital since it is only then that growth positively increases the company's value. If this is not the case, growth initiatives will just accelerate value destruction.

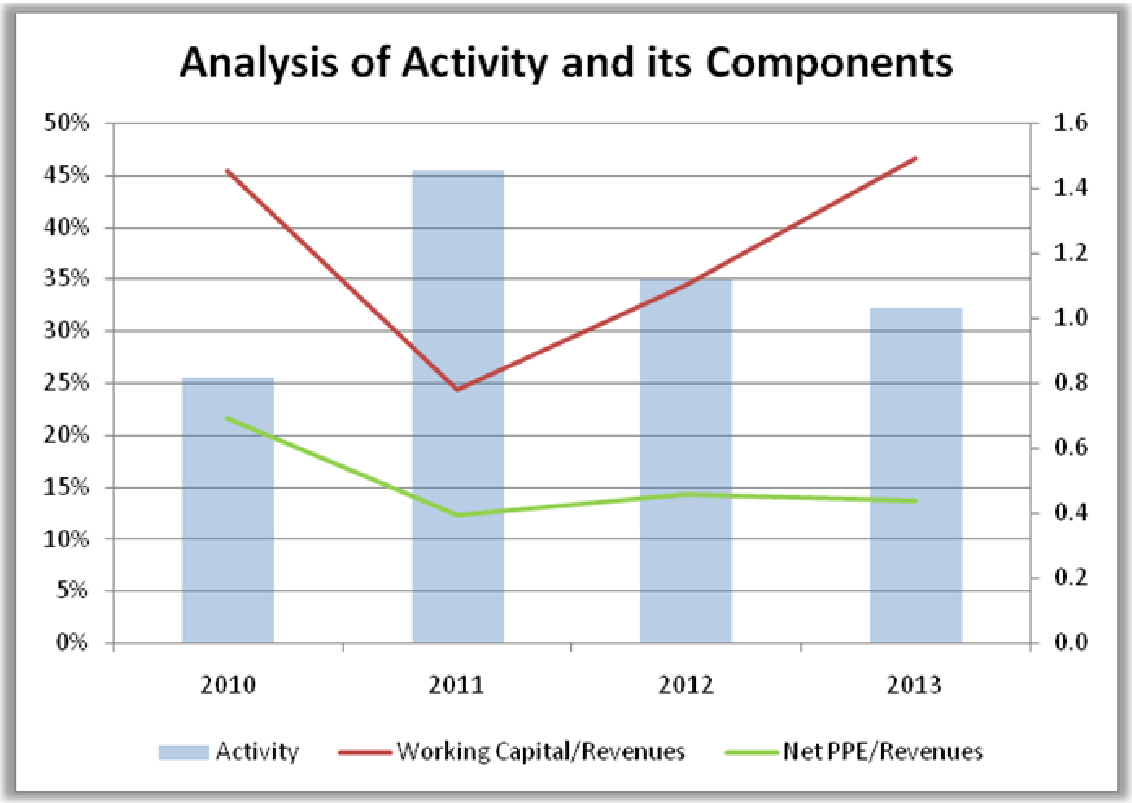
When assessing the value creating performance of the Subsidiary Company it is important to include goodwill in the capital base when return on invested capital is calculated. The goodwill that resulted from a series of bolt-on acquisitions since 2010 combined with a premium paid for the initial acquisition by the Holding Company, require that the return calculation be based on invested capital including goodwill. By including goodwill, $ROIC$ will measure the business' ability to generate value from historical acquisitions given the premiums that were paid.



A decrease in operating profitability combined with lower efficiencies related to asset utilization, are the main reasons for the company's weak *ROIC* performance. The impact of this was that the business consistently realized returns below the cost of capital since 2011. If the business continues to destroy value it will become increasingly difficult to get access to capital at reasonable rates. In the end this business will simply fade away, become a takeover target or succumb to asset stripping raids. The initial focus of this strategy must therefore be on improving profitability as well as capital efficiency in an effort to drive *ROIC* levels higher than the cost of capital.

There are only four performance areas that can be effectively managed to improve operating profit. These are volume, price, fixed expenses, and variable unit costs. The declining trend in the gross profit of the company has contributed most to the weak operating profit performance of the business. In addition certain cost categories such as Sales, General and Administrative (SG&A) costs have recorded strong growth. Arresting the declining trend in operating profit will therefore require an improvement in the gross profit margin by focusing on price and variable unit cost. Secondly, focusing on cost management without compromising capacity and stability will further improve the company's operating profit performance.

As noted above, the weak *ROIC* performance may also be contributed to a decline in capital efficiency as reflected in a declining activity ratio. A decline in this ratio usually suggests that operating assets are increasing at a steeper rate than sales revenue. Having a closer look at the asset components of the activity ratio (fixed assets and working capital) reveals that working capital increased at a rate higher than revenue growth. Since inventory is the largest component of working capital this trend can be turned around by focusing efforts on the reduction of inventory levels without impacting on customer service levels.



A.7.2 Scanning for value optimization opportunities

In this section we will identify those value drivers where an improvement can potentially contribute the most to the intrinsic value of the business. To do this we developed a detailed valuation model of the company. Using the valuation model we are able to perform sensitivity analyses using the value drivers as input measures and the intrinsic value of the business as an output measure.

During the sensitivity analysis a particular variable is varied over a preset range (10 percent up and 10 percent down) while other variables are kept constant. This allows us to isolate the impact of a particular variable on the intrinsic value of the ordinary shares of the business. The results of the sensitivity analyses are as follows:

1. The most significant value impact is realized by varying the level of business' gross profit. A 10% reduction in gross profit can destroy R96 million in intrinsic value while a 10% improvement can add R73.6 million.

2. A variation in SG&A costs has the second most significant impact on intrinsic value. An increase of 10% can reduce the intrinsic value of ordinary shares by R62 million. If however the cost category is permanently reduced by 10% intrinsic value will improve by R51.8 million.

3. A reduction of 10% in Other Operating Expenses will add R8.6 million to the intrinsic value of ordinary shares whereas an increase of 10% will destroy R8.8 million in value.

4. Finally, an increase of 10% in the level of inventory holding has the potential to reduce the intrinsic value of ordinary shares by R6.5 million. By reducing inventory levels by 10% the business can increase its intrinsic value of ordinary shares by R6.4 million.

The sensitivity analysis shows that in order to realize the maximum potential value impact we will need to focus on the decision processes underlying pricing, inventory acquisition and

management, and cost management.

A.7.3 The pricing decision process

Current decision process and outcomes

The decision structure
Prices are currently determined from one transaction to the next and from one customer to the next. The price determination is based on cost plus a mark-up percentage. The mark-up percentage is determined by the representative or call center agent making the sale.

The factors that currently determine the practicality of the pricing decision are:

- Compliance with the minimum mark-up as per company policy,
- The most recent price charged for the product to the customer, sometimes overriding the minimum mark-up policy,
- The size of the transaction, and
- The level of competition for the same deal, especially with large transactions.

Decision efficiency
The mark-up is not linked to any objective business reason such as discounts based on promotions, special deals, or purchase volume. With large contractual accounts a price is negotiated before the contract is concluded.

A lower bound for the mark-up was recently introduced. Apart from this, there is now evidence of structured and disciplined pricing analysis during the process of price determination, whether the transaction is on a single unit or millions of units.

Decision complexity
The complexity of the decision process should not be underestimated. The trade off between margin protection and customer retention is very difficult to comprehend and manage. To make this trade off the pricing decision maker must have an understanding of a particular customer's tolerance for price increases.

Pricing decision makers must also have a clear understanding of the effect that changing product acquisition costs can have on the absolute value of the product's gross profit. If the company is actively working on reducing the acquisition cost of its product range it must upwardly adjust its mark-up percentage to maintain gross profit in absolute terms. This is because the cost plus mark-up approach is the only pricing mechanism employed by the company at the moment.

It is because of this complexity that pricing decision makers tend to fall back on the historical price charged for a particular product and customer combination.

Decision frequency
The pricing decision is a high frequency decision that is made by different decision makers for different products and different customers hundreds of times per day.

Decision impact
The primary driver behind the declining trend in the business' gross profit margin is increased price competition due to the entry of new players and a general decline in demand. These two factors in combination resulted in a price war that left businesses with dramatically lower gross profit margins. Historical efforts focused on adjusting the cost structure of the business to deal with the new reality have had very little positive impact on the value of the business. We would

like to submit that the starting point for finding a high value impact solution lies in rational and disciplined price determination.

Proposed decision process and outcomes

In order to optimize the pricing decision process we envisage the implementation of an integrated Price Management System. The introduction of such a system into the pricing decision process will impact most of the decision process dimensions such as structure, efficiency, complexity, and impact. Pricing frequency will remain the same.

Decision structure Instead of making pricing decisions at the point of sale the sales person is presented with pricing recommendations. The decision that the sales person needs to make at this point is limited to acceptance or rejection of the recommended price.

Decision efficiency The recommended price will take all of the following into consideration for every transaction and for every customer:

- Compliance with the minimum mark-up as per company policy,
- The pricing history associated with a particular customer,
- The potential for maximizing the deal value without alienating the customer, and
- The current market price for the product.

Decision complexity
From the sales person's perspective the Price Management System will reduce the complexity of the pricing decision to a single choice - accept or reject the recommended price. The system will effectively accommodate the complexity associated with optimal price determination.

Decision impact
By accepting the pricing recommendations made by the Price Management System the gross profit margin of the business will increase to the minimum targeted level as determined by the minimum mark-up policy. By exploiting higher pricing opportunities that exists on individual customer level we expect that the system will realize gross profit margins that far exceed the minimum target set by management. The price management system will also realize small price increments on individual customer level, making broad based price increases unnecessary. The system will be configured to continuously work at increasing the business' gross profit margin.

A.7.4 The inventory acquisition and management decision process

Current decision process and outcomes

Decision structure
Inventory items are sourced from three local manufacturers and six international manufacturers. Local manufacturers work on production cycles of between three and six months. An order is placed per production cycle. This order includes the total volume as well as a staggered delivery schedule over the production cycle. Orders placed with international suppliers are usually in the form of a single large quantity per order cycle. The order cycle for international suppliers can vary from three to four months.

All international orders are placed by the Cape Town branch. The order is divided and shipped in different containers to Cape Town and Johannesburg with the Cape Town portion entering

the country at Cape Town Harbor and the Johannesburg portion entering the country at Durban Harbor. The other branches draw their stock from the Johannesburg and Cape Town distribution centers respectively. Epping, Port Elizabeth, Montegue Gardens, and Saldanha draw inventory from the Cape Town distribution center. Johannesburg, Pretoria and Durban draw inventory from the Johannesburg distribution center.

Currently inventory balancing occurs on a weekly basis between the Cape Town and Johannesburg distribution centers as well as between the Cape Town Distribution center and its regional demand nodes. The frequency of inventory balancing combined with the long distances between the distribution centers and the distribution centers and branches, has resulted in escalating transportation costs.

The factors that influence the practicality of a decision to order inventory from a supplier are:

- The unit price,
- Length and variation of lead times,
- Projected demand over the lead time,
- Minimum order amounts,
- Volume discounts,
- Duties and taxes, and
- Inventory distribution costs.

Decision efficiency
Although cost comparisons occur when deciding on a particular supplier, the scope of the comparison is limited. A comparison of total cost of supply (including inventory distribution and holding cost) associated with a particular supplier compared to another, does not occur.

In an effort to streamline supplier selection, product ordering, and price negotiation, management is currently considering the centralization of the inventory purchasing activity at the Cape Town distribution center. All other branches will however be allowed to make "emergency buyouts" of inventory items from local competitors when needed.

In order to reduce the level of inventory holding, management introduced the following demand estimation, reorder point, and order size calculations:

- The demand forecast is based on 13 months historical data. Potential outliers are addressed by removing the two highest and one lowest month in the data set. The remaining ten months are then added and an average demand per month is calculated.
- For local suppliers, the reorder point is set at one and a half months the average monthly demand and for international suppliers the reorder point is set at four months average monthly demand.
- The order amount is determined by calculating the difference between the maximum level of inventory holding and the reorder point. For local manufacturers the maximum inventory level is set at two months worth of average demand and for international manufacturers it is set at six months worth of average demand.

Decision complexity
Every time an inventory replenishment order is placed, the decision maker needs to determine the number of units of a particular product that must be ordered from a particular supplier at a particular point in time. In addition the decision must take onto consideration the final

destination of the order, since it is the demand for the product at a particular branch that must be met. Adding aspects such as price variation between suppliers, volume discount, minimum order size, transportation costs, and inventory holding cost to the mix, it is clear that the optimal decision on order size, supplier choice and distribution path with the aim of minimizing acquisition and inventory holding cost, is highly complex.

Decision frequency
At the moment, local orders are placed every six months and international orders every three to four months. The decision frequency is at most four times a year, but relates to thousands of inventory items at a time. The business carries close to 35,000 inventory items.

Decision impact
The variable cost per unit is, next to pricing, the most critical determinant of gross profit margin. As noted before, gross profit margin levels have changed dramatically since 2010. It is important for the business to recover some of the intrinsic value it has lost as a result of deteriorating market demand and the price war that followed.

The proposed decision processes and outcomes

In order to achieve optimality in this decision process we propose the implementation of an Inventory Acquisition and Management System. The system will dramatically change the current structure of the decision process, improve decision efficiency, and reduce complexity.

Decision structure
The focus of the staff in the purchasing department will shift towards supplier management since the optimal reorder points and order sizes will be taken care of by the new planning system.

The focus of decision making in the department will change to the decisions related to the inclusion or not of suppliers in the central supplier database that is used by the planning system. The inclusion decision would be based on a number of factors in addition to pricing and discount structures. The length and variability in the lead time, differences related to import duties, and minimum order size requirements are all aspects that will play a role. A specific set of criteria will also be developed for the inclusion of transport service providers in a provider data base.

There may still be inventory balancing, but this should be the exception rather than the rule. The Inventory Acquisition and Management System will ensure that the right product is at the right place at the right price.

Decision efficiency
The system will be able to determine the optimal reorder amount and reorder point for each inventory item by distribution center and by branch. Suggestions will therefore be made related to a specific order amount from a specific supplier for a specific distribution center having taken into account all variables that determine inventory acquisition and holding cost. These suggestions will be fully automated and integrated with the current transactional system of the business.

Decision complexity
The elements that contribute to the complexity of the current decision process will be handled by the new planning system. These elements include supplier selection, order amount, and distribution decisions that are made with the aim of minimizing inventory acquisition and holding cost.

Decision impact
An improvement in this decision process will have a double impact on the ability of the company

to generate higher returns on its invested capital. In the first instance there will be a reduction in the acquisition cost of inventory which will have a positive effect on the gross profit and therefore operating margin of the business. Secondly, inventory holding will decline resulting in a lower capital base on which returns are generated. The combined impact is a strong increase in $ROIC$ and therefore economic profit.

A.7.5 Specification of proposed analytics applications

Price management system

Objectives and fundamental principles
The objectives of such a system will be to:

- Introduce pricing discipline in the business,
- Protect the gross profit margin,
- Minimize customer churn as a result of incorrect pricing,
- Take advantage of pricing opportunities arising from the different demand and competitive profiles at branch level.

The price management system will incorporate a number of fundamental principles:

- It must allow for branch level price determination,
- It must limit the risk of losing business due to sub-optimal pricing,
- It must not leave any money on the table.

Integration with current decision processes
The pricing decision is a critical element of the sales process. Before placing the order the customer will request a price quote. If the price is satisfactory, the customer then places an order.

The pricing system will use

- The most recent price at which this product was sold to this customer,
- The product cost,
- The list price of the product,
- The minimum required gross profit margin for this product, and
- Specific preset model parameters to calculate the best price for this product and customer.

The pricing system will return the calculated price as a price recommendation to the employee. The employee accepts or rejects the recommendation. If rejected, the employee must provide a motivation and an alternative price.

Application description
The Price Management System consists of three main sub-routines. These are:

- The Policy Price Sub-Routine which anchors the suggested price,
- The Pricing Logic Sub-Routine which selects a price level, and
- The Price Increment Sub-Routine which suggests a price increase.

The policy price sub-routine
The policy price sub-routine is used to calculate the minimum pricing bound for the customer and product combination. It uses the target gross profit margin, the product cost, and the list price of the product to calculate a Maximum Allowable Mark-up Price and a Maximum Allowable Discount Price. The next step would be to calculate the value of gross profit that is associated with each. The price bound that is associated with the highest gross profit value becomes the Policy Price for this particular product. The aim is to anchor the suggested price to either product cost or list price, whichever results in the highest gross profit margin.

The pricing logic sub-routine
This sub-routine uses a set of logical statements or rules to move the price into a pre-set price range. The primary objective of this sub-routine is price level correction. If the most recent price is below the minimum allowable policy price, it corrects the price level by setting the suggested price equal to this minimum price level. If the price level is however higher than the list price (a very unlikely scenario) the system correct the price level by setting the suggested price equal to the list price. The list price represents the upper bound of the pricing range. If the customer is purchasing the product for the first time, the system currently suggests the list price. Finally, if the most recent price lies between the policy price and the list price, the algorithm branches to the Price Increment Sub-Routine which manages the progression of the suggested price from its current level to list price level.

The price increment sub-routine
The price increment sub-routine calculates a price increase based on the upward price progression of the most recent price when compared to the policy price. Using an exponential decay function, parameterized by a shape and a maximum price increment parameter, the relative distance from the most recent price is used to determine the increment applicable to the current price. The increments decrease in magnitude as the distance from the lower bound, represented by the policy price, increases. The rate at which the suggested price increments revert to zero is determined by the shape parameter. The maximum allowable price increment is determined by the second model parameter. The price progression continues until the list price is attained.

Specific design requirements The model parameters, including the target gross profit margin percentage, can be adjusted based on the competitive profile associated with a particular branch. In this way, the business can deploy a pricing strategy that is specific to each branch.

The branches in the business have very distinct characteristics in terms of the level of competition and the size of the opportunities in the market. The branch profiles and the suggested model parameter settings are as follows:

- Pretoria, Johannesburg, and Epping are operating in highly competitive markets to the point where the profit potential of opportunities can be completely eroded. Pricing in these markets should be focused on avoiding a price war. The model settings for this type of market environment should restrict the target gross profit margin percentage to a lower level, restrict the maximum allowable price increment to a lower level, and ensure that the level of suggested price increments regress to zero quickly.
- Salhanha is operating in a market with low competitive intensity but the growth opportunities are somewhat limited. In this environment it is best to maintain steady prices. For this branch the model setting would include maintaining the target gross profit margin percentage, maintaining the maximum allowable price increment, but increase the rate at which price increments revert to zero. This will result in smaller price increments and therefore a slower progression to the list price level.
- The Durban market is characterized by relatively high levels of competition and strong

growth opportunities. In this environment pricing should be focused on capturing market share. For this market the suggestion will be to keep the gross profit margin percentage setting on target level, the maximum allowable increase on less than the standard, and the rate at which increments regress to zero on a reduced level to allow for medium sized increments on a regular basis.

- The Port Elizabeth branch is characterized by strong growth opportunities and relatively low levels of competition. This environment presents an opportunity for premium pricing. For this branch the gross profit margin target can be increased, the maximum allowable price increment can increase, and the increment regression towards zero can be reduced. All of this will result in a relatively rapid price progression towards list price.

Inventory acquisition and management system

Objectives and fundamental principles

The aim of the system will be to minimize inventory holding and procurement costs by:

- Optimizing supplier selection,
- Optimizing order sizes and reorder points, and
- Optimizing inventory distribution.

The fundamental requirements of the inventory acquisition and management system are:

- Comprehensiveness - The system must select suppliers by assessing all operational and financial aspects of product supply including:
  - Acquisition costs which is determined by:
    - Supplier list price,
    - Volume discount structure,
    - Importation costs, and
    - Transportation costs.
  - Reliability of supply, which is determined by:
    - The length of lead times and
    - The variability of lead times.
- Optimality - The system must set order size and reorder points to:
  - Minimize average inventory holding during the year, and
  - Manage the risk of running out of inventory which is sure to impact negatively on customer service levels.
- Integration - The system must be easily integrated with the current transactional systems.
- Flexibility - The system must generate inventory management plans at individual branch level.

Integration with current decision processes

The Inventory Acquisition and Management System is essentially a planning solution and will replace the current inventory planning system. The output of the system will consist of order quantities by supplier and reorder points by product by distribution center. The current

transactional system will use the system output to generate order recommendations on specific suppliers at DC level or order recommendations on specific DCs on branch level. The order recommendation can be accepted or rejected with motivation by the employees responsible for order collating and order placement.

Application description
The system can be divided into two main systems namely the branch-level system and the Distribution Center-level or DC-level system. The output from the branch-level system feeds into the DC-level system.

The process starts with analyzing the demand profile for each product by branch. The output of this analysis is in the form of a daily demand probability distribution. The probability distributions are used as the primary input for simulating the demand and delivery pattern for the particular product and branch combination. The aim of the simulated optimization process is to find the order quantity and reorder point for a particular product and branch that will result in the lowest possible distribution and inventory holding cost while taking into consideration the uncertainty of customer demand.

The ordering patterns, which include the order quantity and the time interval between orders, of a particular product are now aggregated across all the branches that are associated with a specific DC. The aggregated ordering patterns constitute the demand profile for this product at DC level. The DC-level demand profiles are now used to simulate the ordering and delivery process associated with a combination of international and domestic suppliers. The order amount placed at a particular supplier is the result of the minimization of the acquisition cost, distribution cost (from port to DC or form supplier to DC) and the inventory holding cost (based on average inventory holding and the cost of capital) associated with that specific product.

For every planning cycle the Inventory Acquisition and Management System will generate an output file. The output of the system will be in a flat file format that contains the following data elements at distribution center level:

- Product order quantities by supplier and
- Product reorder points.

This flat file will be imported into a stock management database that will be accessed by the current transactional system. To effectively use the order quantity and reorder point recommendations we will develop a routine in the transactional system that will compare the current stock level at the DC with the reorder point and generate product orders of size equal to the optimal order quantity when the stock level is lower than the optimal reorder point.

At branch level the flat file will consist of:

- Product order quantities and
- Product reorder points for that specific branch.

When the inventory level reaches the optimal reorder point for that branch, the transactional system will generate an inventory order recommendation for ordering the optimal order quantity from the branch's associated DC.

Specific design requirements
The problem of determining the optimal order quantity and reorder point is resource intensive due to its reliance on simulation. The simulation aspect of the solution allows us to test the full range of potential ordering patterns associated with a particular branch and product. It also allows us to effectively accommodate demand and lead time uncertainty. However, the structure

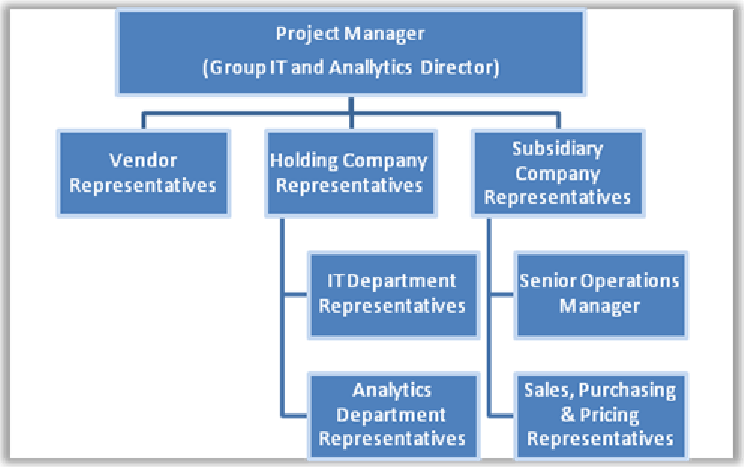
of the problem is such that it can be sub-divided into independent problems which can be solved across multiple hardware platforms.

The first stage of the problem requires generating demand profiles for at most 245,000 branch and product combinations (based on 7 branches and 35,000 inventory items). Each of these profiles can be determined independently. The next stage of the problem requires finding the optimal order quantity and reorder point for the 245,000 branch and product combinations using the demand profile generated during the first stage. Again, each of these problems can be solved independently once it receives the demand profiles from stage one. The third stage involves adding the order quantities determined in stage two across the different branches per DC to create the demand profile for each of the DCs. This problem involves 70,000 independent summing operations based on the two DCs and 35,000 inventory items. Finally, the order quantity by supplier as well as the reorder point is determined by DC for each product. This stage can again be represented as 70,000 independent problems that need to be solved.

This problem granularity can be exploited to ensure realistic and workable solution times.

A.7.6 Project team

The project team will consist of a combination or external and internal resources. The external resources will mainly be the representatives from the analytics platform vendor. The internal resources will be representatives from the Holding Company as well as the Subsidiary Company. The Holding Company resources will include representatives from IT, the analytics department and the Group IT and Analytics Director who will also take up responsibility of project manager. The Subsidiary Company will have a senior operations manager as well as representatives from sales, purchasing, and pricing on the project team. It is important that representatives from the Subsidiary Company include future users of the proposed applications. User involvement during the application development phase of the project is absolutely critical for success. Following is the suggested project team structure:



A.7.7 Next steps

The Subsidiary Company Decision Optimization Project will start with the development of the Price Management System. The prototype will be implemented and tested at a specific branch in the Subsidiary Company group. Once the project team is comfortable with the performance of the application the roll out to the remaining branches will start.

In parallel with the roll out of the Price Management System, development on the Inventory Acquisition and Management System will start. The development and testing will be done at Distribution Center level. Once the project team is confident with the results of the prototype testing at the first DC the application will be implemented at the second DC.

A.7.8 Delivery time frames

The Subsidiary Company Decision Optimization Project will be implemented over a period of ten months. Most of the work streams are sequential with the exception of work stream number four and five which can be run in parallel.

ID Nr	Work Stream Description	Expected Duration in Months
1	Requirements Specification Sessions	1
2	Price Management System Prototype Development	3
3	Price Management Prototype Testing	1.5
4	Price Management System Roll Out	1
5	Inventory Acquisition and Management System Prototype Development	1
6	Inventory Acquisition and Management System Prototype Testing	2
7	Inventory Acquisition and Management System Roll Out	1.5
	Project Completion	10

A.7.9 Net value impact

The impact of the Price Management System and the Inventory Acquisition and Management System on the future gross profit performance of the business is projected to be as follows:

Year	GPM% without Intervention	GPM% with Intervention	Potential Improvement
2014	40.84%	41.65%	0.82%
2015	42.34%	44.03%	1.69%
2016	42.34%	44.88%	2.54%
2017	42.34%	45.72%	3.39%
2018	42.34%	46.57%	4.23%

The impact of the two systems on the projected inventory holding levels (expressed as a percentage of sales) of the business is as follows:

The combined impact of the two systems on the intrinsic value of the ordinary shares of the business is an estimated increase of **R52,700,000**[1].

[1]The improvements in gross profit margins and inventory holding levels are estimates. A direct evaluation of potential impact will be based on back testing the proposed applications on transactional level historical data. This is a resource intensive exercise since fully functioning applications would have to be developed which falls outside the scope of the current research

Year	Inventory% without Intervention	Inventory% with Intervention	Potential Improvement
2014	26.35%	25.82%	-0.53%
2015	23.85%	22.89%	-0.95%
2016	23.18%	21.79%	-1.39%
2017	22.22%	20.44%	-1.78%
2018	21.00%	19.44%	-2.16%

From this we need to deduct the costs associated with project implementation. Direct costs associated with the Subsidiary Company project are mainly consulting fees estimated at R2,500,000. In addition a portion of the costs associated with the centralized analytics department must also be allocated to the Subsidiary Company Decision Optimization project. These include annual personnel costs of R5,450,000, software implementation costs of R2,500,000 and annual software licensing fees of R200,000. Using an allocation factor of 20% the total present value cost associated with the project amounts to R11,961,142. The net increase in intrinsic value associated with this project is therefore estimated to be **R40,738,858**.

We are able to estimate the potential net increase in market value and therefore shareholder wealth based on the assumption that market value deviates from intrinsic value by not more than 20%. The upper bound of the net market value increase is estimated to be **R51,278,858** and the lower bound is estimated to be **R30,198,858**.

APPENDIX B

Detailed survey data

Contents

B.1 Qualitative feedback

B.1.1 Group managing director (GMD)

1. How convinced are you that you should continue reading?		
Rating: Convinced	**Why?** The potential increase of R30m to R50m is significant and demand more insight into this strategy.	**Additional notes:** According to the respondent the increase in value and competitive advantage is the same thing.
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		
Rating: Convinced	**Why?** The only competitive advantage in today's business world it the ability to make and implement critical decisions in a very short time.	**Additional notes:**
3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Convinced	**Why?** See above (question 2)	**Additional notes:**
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		

Rating: Somewhat convinced	**Why?** Although a very useful tool, it requires a lot of assumptions, and is never precise. I will not use intrinsic value as the only measurement.	**Additional notes:** The key value drivers should also be tracked.
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Convinced	**Why?Intrinsic value reduces the subjective perception of a stock's value and gives a clearer indication of a company's financial health and therefore shareholder value.**	**Additional notes:**
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Convinced	**Why?** Profits = Ability to make the correct decisions in time. Optimizing decisions = Profits = Shareholder's value.	**Additional notes:**
7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		
Rating: Convinced	**Why?** See question 6.	**Additional notes:**
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		
Rating: Not convinced	**Why?** We need a business tool that can be used by operational or senior managers to optimize decision making. Simplicity and ease of use is the key.	**Additional notes:**
9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Not convinced	**Why?** This should form part of the current management team's responsibility because they are the ones that know the assumptions and the realities of the business.	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?** Advanced analytics is only possible through an analytical culture due to the complexity. The culture should be at all levels and away from a department.	**Additional notes:**
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Not convinced	**Why?** Culture = Senior management team. If senior management support analytics and can practically convince the rest of the team of the benefits the culture will be established.	**Additional notes:**

12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?** The modeling is only as good as the assumptions which are correlated to the business insight.	**Additional notes:**
13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Not convinced	**Why?** I would rather outsource the critical skills than have management doing the modeling.	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Convinced	**Why?** These skills form the basis of optimization modeling and are critical for success.	**Additional notes:** The breadth of analytical skills has been emphasized by the respondent. The paragraph on advanced application development skills has also been highlighted.
15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Not convinced	**Why?** My perception is that simpler options are available that can do this type of modeling.	**Additional notes:** Are there no simpler technological solutions that can deliver the same impact? Standardization on a single platform is an option only if it can be tightly integrated with the ERP solution.
16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		
Rating: Convinced	**Why?** If such an appointment will be done, it should report directly to the Group MD or FD.	**Additional notes:** The financial director will have the most need for the services of an analytics specialist. Initial financial forecasts that are presented to the FD are subjected to a process of finding additional improvement opportunities and this will be one of the responsibilities of the analytic specialist.
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Not convinced	**Why?** As mentioned, I will outsource such a function and not appoint a full time person.	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		

Rating: Not sure	**Why?** Given the technical expertise needed for such a department, I would assume the positions are needed. My view would be that an analytics specialist can work with the current IT team.	**Additional notes:** The reporting line will however not be to IT. The respondent is adamant that the specialist nature of the analyst would make it difficult for an IT manager to understand and manage this individual.
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Not convinced	**Why?** I don't see this as a separate department but an expert that is included in the current structure.	**Additional notes:**
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Convinced	**Why?** Keep it simple. Choose the best applications and focus on that.	**Additional notes:** The respondent underlined two sentences in this section. The first sentence gives a description of the problem as it relates to data quality, integrity and consistency. The second underlined sentence relates to the fact that companies already have the data that they need to make more effective decisions.
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Somewhat convinced	**Why?** There is always a "Good enough" principle. Development cost needs to create value, and need to give enough value above cheaper more simplistic tools.	**Additional notes:**
22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		
Rating: Convinced	**Why?** Any system that has no business relevance will not be used and will be redundant over time. (Practical/easy to use/outcomes understandable by operations managers).	**Additional notes:**
23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Somewhat convinced	**Why?** The practical implementation of the outcome is more important than the actual in depth understanding of the processes.	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		

Rating: Not convinced	**Why?** Did not understand the question	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Convinced	**Why?** It must form part of the day-to-day decision making processes.	**Additional notes:** An integrated solution that does not require additional work, unless the impact is highly beneficial to the user, that can be delivered as an add-on to the ERP system is the ideal. One interface, one platform. The integration must also accommodate reporting that is specific to the application.
26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Somewhat convinced	**Why?** The practical outcomes of enhanced decision making play a bigger role than application transparency. The question is does the output support gut feel?	**Additional notes:** Practical!!
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		
Rating: Not convinced	**Why?** Transparency is only possible through the practical use and trust in the tool. Technical detail is not important - deliverables are.	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?** Any analytical tool will be evaluated by the users against alternatives. Balance between complexity and worth.	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: Convinced	**Why?** If a tool does not support gut-feel it will not be used. Users have a lot of experience in their field and value drivers are known and managed on a daily basis.	**Additional notes:**
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		
Rating: Convinced	**Why?** Yes, but the value over time will support commitment. Value creation will drive the level of support	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		

Rating: Convinced	**Why?** I don't see that the front line managers need to fully understand the detail of the tool, therefore rather spend time on commitment than detail. Outcomes will drive application adoption.	**Additional notes:**
32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Not convinced	**Why?** The value of the tool will support commitment and not incentives.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Convinced	**Why?** The better they know the tool the more worth they will get out of it.	**Additional notes:** Incentive payments must be limited to the achievement of business goals (with or without the help of an analytics application). Incentives must NOT be linked to actual usage of the system.
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		
Rating: Convinced	**Why?** It is in line with the real figures and performance of the company.	**Additional notes:**
35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?		
Rating: Convinced	**Why?** We maintained sales, but the GP declined due to competition in the market. The increase in stock levels was due to new branches that were added.	**Additional notes:** Historical strategic plans presented by the MD of the subsidiary company listed the following key focus areas: • Increase turnover • Decrease costs including costs associated with stock holding • Increase gross profit margin percentage and value
36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?		
Rating: Convinced	**Why?** In a competitive market you buy your profit you don't sell it. Price increases will result in increased levels of GP and NP. A reduction in acquisition cost should have the same result if prices are kept at the same level. Operating capital is reduced by decreasing inventory levels.	**Additional notes:** Potential for price increases is limited. This is the main driver of his philosophy that profit is a function of purchasing efficiency and not of pricing.

37. How convinced are you that the current price management decision process is sub-optimal?		
Rating: Convinced	**Why?** Lack of a systematic decision approach. Manage GP% and not Rand value. Better acquisitions lead to lower selling prices and not more GP in value terms.	**Additional notes:** List price less? The price determination mechanism is not based on a markup but rather on a "List Price" less a discount. The list price is calculated using cost times a factor. This indirect method of markup calculation is a standard industry approach to pricing and not specific to the subsidiary company. GP% increase does not necessarily result in GP Rand Value increase. Example of impact of reduced acquisition cost based on a suggested markup of 40%. Current: Cost + Markup = Selling Price R10 + 40% = R14 results in a GP of R4 Reduced acquisition cost: R8 + 40% = R11.20 results in a GP of R3.20
38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?		
Rating: Convinced	**Why?** These recommendations were implemented through another system and realized the expected results.	**Additional notes:**
39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?		
Rating: Convinced	**Why?** Double handling of product. Service delivery issues.	**Additional notes:** Correction: The order cycle can vary from three to six months.
40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?		
Rating: Convinced	**Why?** Reduce inefficiencies. Should be part of ERP and not an add-on.	**Additional notes:** Should be part of ERP.
41. How convinced are you that the Price Management System has been thoroughly considered?		
Rating: Convinced	**Why?** It is important that market price or the potential selling price is taken into account.	**Additional notes:** Market price? - The determination of the market price and its relation to list price as mentioned in the model is not clear.
42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?		
Rating: Convinced	**Why?** It takes every possibility into account and allows for variable and numerous outcomes.	**Additional notes:**

43. Are you convinced that the proposed project team will be able to deliver on the project?		
Rating: Convinced	**Why?**	**Additional notes:**
44. Are you convinced that these are indeed the next steps to get the project going?		
Rating: Somewhat convinced	**Why?** Should it not be seen as a holistic model or can it be implemented by branch? I agree with it as a next step.	**Additional notes:**
45. How convinced are you that the delivery time frames are realistic?		
Rating: Somewhat convinced	**Why?** Is it possible to do the modeling for the business as a whole?	**Additional notes:**
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Convinced	**Why?** We need to take into account the constraints of the market in terms of GP%. Mix between branches.	**Additional notes:**
47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		
Rating: Somewhat convinced	**Why?** Many of what is recommended was implemented with good results: • Increase in GP% • Decrease in stock levels • Sales stabilized • Transport cost decreased	**Additional notes:**

Table B.1: Qualitative feedback: Group managing director

B.1.2 Group financial director (GFD)

1. How convinced are you that you should continue reading?		
Rating: Convinced	**Why?** Because between R30 million and R50 million worth of value can be created.	**Additional notes:**
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		
Rating: Somewhat convinced	**Why?** Just partially because these abilities and offerings must be executed in practice to realize a benefit.	**Additional notes:** He emphasized the portion referring to the development and implementation of a newly created analytics department. This will only be a consideration if a practical implementation has positive results.

3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Not sure	**Why?** Because I have not seen it in practice. Also because it must to implemented in practice first. Will not create the capability myself. Will buy what is already working.	**Additional notes:**
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		
Rating: Not sure	**Why?** Because the annual future profit is not only influenced by analytics initiatives.	**Additional notes:** He does not seem to agree with the definition of intrinsic value and that of market value. These were emphasized in the text. He feels that the impact of capital intensity is not clearly demonstrated. He used an example of a capital intensive business such as a mine to argue that capital intensity plays an important role in determining the attractiveness of a business.
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Convinced	**Why?** Because it is the value of net assets plus future profits. However, future capital replacements and expansion as well as capital required to maintain working capital are not included.	**Additional notes:**
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Somewhat convinced	**Why?** There is still uncertainty relating to how you will practically roll it out.	**Additional notes:** He wanted to know why I don't use Equity with reference to the ROIC% in the formula for calculating Economic Profit. He is also not convinced of the practicality of the link between decision optimization and increases in shareholder value.
7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		
Rating: Convinced	**Why?** If you make decisions based on incorrect information it will have a major impact on your performance.	**Additional notes:** He equates good information to good decisions. He also stated that human decision making remains the most important component.
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		

Rating: Not convinced	**Why?** I am not convinced because: • I would first like to see how it will work in practice. • I will appoint a consultant first on a profit share basis and if the results are positive and there are strong indications that a full time approach is more appropriate then I will consider a full time approach.	**Additional notes:** He is risk averse and would rather use analytics on a project by project basis using external consultants.
9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Not convinced	**Why?** For the same reasons as in Question 8.	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?** Because if it is not part of the culture it will not be executed.	**Additional notes:** Analytics in his view is financial analysis in the form of ratios and performance measures such as Return on Equity.
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Not sure	**Why?** Refer to Question 8 for background. The MD and his team must believe in it and drive it at every opportunity demonstrating its advantages. If there are enough advantages and these are repeatable then a manager will be appointed. The process will also start with a junior rather than a senior appointment.	**Additional notes:** The current team must promote the culture. He will not appoint a senior manager responsible for analytics.
12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?** Definitely, because if the consequence of the business are not understood then no decisions can be made.	**Additional notes:**
13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Convinced	**Why?** Would rather appoint someone than develop. Development can take a lot of money and time and results can take a long time to realize.	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Convinced	**Why?** Yes, they must have the skill set to make decisions.	**Additional notes:**

15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Convinced	**Why?** Under the assumption that a central department is created. You cannot work without the right tools.	**Additional notes:**
16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		
Rating: Not Sure	**Why?** I will let the position report to the Financial Director.	**Additional notes:** The department head must report to the FD. The FD knows the potential impact areas across the business and can translate the results of the analysis to facilitate implementation. The ideal however, would be for the analytics manager to report directly to an operations director. This way you will ensure front line staff buy in.
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Somewhat convinced	**Why?** Yes because interaction between the IT and the analytical department would be important.	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		
Rating: Not sure	**Why?** No, you must start small and show bankable impact and as the requirement increases so more personnel can be added.	**Additional notes:**
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Not convinced	**Why?** Must first see what the annual contributions will be before such a department will be created. In short, the annual contribution to bottom line must be more than double the cost.	**Additional notes:** Once a business is optimized the analytics work is done and there will be nothing left for this department to do.
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Convinced	**Why?** The answer is only as good as the quality of the data.	**Additional notes:**
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Convinced	**Why?** It must fit the specific business and processes.	**Additional notes:**
22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		

Rating: Convinced	**Why?** Totally, because you cannot make decisions based on the science only. It must take your other skills into consideration.	**Additional notes:**
23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Convinced	**Why?** In order for the application to adapt to the relevant business.	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		
Rating: Not sure	**Why?** Not totally convinced. I think that the best results may be achieved if the analyst role is filled by a person with operations experience.	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Convinced	**Why?** If it is not integrated it will be a separate system that will not be used.	**Additional notes:**
26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Convinced	**Why?** I think that it is important that the person sees that it works in practice and that it increases the bottom line. Furthermore it must not increase the person's administrative burden.	**Additional notes:**
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		
Rating: Convinced	**Why?** Yes, because he can see the advantages.	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?** The more user-friendly it is the more it will be used.	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: Convinced	**Why?** The decision makers must be allowed to use their own judgment. They can however be allowed different levels of deviation.	**Additional notes:** The level of deviation is determined by the seniority of the decision maker.
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		
Rating: Convinced	**Why?** Definitely since if front line staff and managers do not buy in it will not work.	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		

Rating: Somewhat convinced	**Why?** It is not about the percentage resources that you throw at the project that will determine success. Success will be determined by:The financial impact, ease of use, and senior management buy in.	**Additional notes:**
32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Not sure	**Why?** I do not think that incentives must be used to ensure commitment because it is short term. If the project creates value then there will be commitment.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Somewhat Convinced	**Why?** It must not take too much time since people will experience it as a burden.	**Additional notes:**
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		
Rating: Somewhat Convinced	**Why?** External factors such as economic growth and new market entrants were not discussed. Other aspects such as import duties should also be taken into consideration.	**Additional notes:** He emphasized "The declining trend in gross profit" and noted external factors.
35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?		
Rating: Convinced	**Why?** This is why net profit declined. The decline in sales also played a role.	**Additional notes:**
36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?		
Rating: Convinced	**Why?** This is correct, but you can also only reduce as far as the market allows you to.	**Additional notes:**
37. How convinced are you that the current price management decision process is sub-optimal?		

Rating: Somewhat convinced	**Why?** If the number of products, transactions and types are taken into consideration then the market pricing is relatively effective.	**Additional notes:** The company does not work on a cost plus markup mechanism. It uses a factor of 2.87 multiplied by cost and then discount the resulting "list price" with anything between 40% and 60%. He noted that the negative assessment of decision efficiency is based on the incorrect assumption that a market price is objectively determined. He seriously doubt if analytics can provide workable solutions given the complexity and scale of the problem.
38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?		
Rating: Not sure	**Why?** It is my perception that sales are made at market price. I think that by paying sales representatives a commission based on gross profit in value terms it will definitely improve.	**Additional notes:** Where will you get this? - with reference to the market price. Also, a minimum markup policy will need to be determined by product type which will dramatically increase the complexity of the proposed solution. There are two product types - High tensile steel which generally work on a GP margin of about 25% and soft steel which works on a margin of between 55% and 65%. He used an example of the potential impact of a large deal on High Density steel on the overall profit margin since for this particular deal the products were sold at a GP margin of 18%.
39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?		
Rating: Somewhat convinced	**Why?** The number of items and the difficulty related to demand forecasting makes it very difficult.	**Additional notes:** He does not agree with parts of the assessment relating to the decision structure of the Inventory Acquisition and Management Process. Specifically the fact that stock levels are realigned between branches on a monthly basis and not weekly as before. With reference to decision frequency he noted that international orders take 6 months because it spends 4 months on the water.

40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?		
Rating: Convinced.	**Why?** The current system is not easy enough to support purchasing.	**Additional notes:**
41. How convinced are you that the Price Management System has been thoroughly considered?		
Rating: Not convinced	**Why?** Because sales and margins are assessed on a daily basis.	**Additional notes:** The pricing logic should be changed so that the suggested price is equal to most recent price even if the most recent price is higher than list price.
42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?		
Rating: Not convinced	**Why?** Currently busy investigating an ERP system. Must decide between SAGE and SYSPRO.	**Additional notes:**
43. Are you convinced that the proposed project team will be able to deliver on the project?		
Rating: Not sure	**Why?** Need more detail on the project before I can form an opinion. Information such as: • What the saving will be? • What will it cost? • Once the project is complete what will happen to the team?	**Additional notes:**
44. Are you convinced that these are indeed the next steps to get the project going?		
Rating: Not sure	**Why?** See answer to question 43. Need much more information.	**Additional notes:**
45. How convinced are you that the delivery time frames are realistic?		
Rating: Not sure	**Why?** I have no feeling for the time that is needed. I therefore cannot comment.	**Additional notes:**
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Not sure	**Why?** I cannot see how the GP can increase from 40% to 46% without losing sales. Furthermore, you will only be able to lift part of the business' GP which means that it will have to increase by much more than 6%. Here I am referring to Johannesburg's sales that are governed by contracts.	**Additional notes:** The net value impact should be presented in value terms and not in percentage terms. The potential value impact should be based on transactional level back testing. But even with that he would only be half convinced that analytics is the way to go.
47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		

Rating: Not sure	**Why?** I am not prepared to spend R2.5 million in capital and salaries of R5 million on something that I have not seen working before. I would rather appoint a consultant on a profit share basis.	**Additional notes:**

Table B.2: Qualitative feedback: Group financial director

B.1.3 Divisional operations director (DOD)

1. How convinced are you that you should continue reading?		
Rating: Convinced	**Why?**	**Additional notes:**
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		
Rating: Somewhat convinced	**Why?** Decisions are made with the same basic rules.	**Additional notes:**
3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Somewhat convinced	**Why?** Consideration must be given to whether it can add value or not.	**Additional notes:**
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		
Rating: Not sure	**Why?** I think that there are other factors that must be taken into consideration. Trademarks, capital required for growth.	**Additional notes:**
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Not sure	**Why?**	**Additional notes:**
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Somewhat convinced	**Why?** It is a more complete process with a definite outcome.	**Additional notes:**
7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		
Rating: Convinced	**Why?**	**Additional notes:**
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		
Rating: Somewhat convinced	**Why?** A focused department with ownership will be able to meet objectives.	**Additional notes:**

9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Somewhat convinced	**Why?** Specialist area	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?** Must have ground level participation in order to achieve objectives.	**Additional notes:**
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Convinced	**Why?** The strategy will only be successful if the department is managed by a specialist.	**Additional notes:**
12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?** Detailed knowledge and information will lead to an accurate implementation of the strategy.	**Additional notes:**
13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Convinced	**Why?**	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Somewhat convinced	**Why?** It is critical to involve the specialists (subject matter experts) on the particular decision process.	**Additional notes:**
15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Somewhat convinced	**Why?** There is currently a need. It brings with it an opportunity for increased profit.	**Additional notes:**
16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		
Rating: Convinced	**Why?** It is the only way that buy -in can be realized.	**Additional notes:**
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Somewhat convinced	**Why?** The two departments are integrated.	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		

Rating: Not sure	**Why?** We can get to this structure over time. Initially the structure would be small allowing it to grow into the complete department.	**Additional notes:**
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Not sure	**Why?** See Question 18.	**Additional notes:**
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Somewhat convinced	**Why?** Attention to correct data is critical since assumptions would be based on it.	**Additional notes:**
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Somewhat convinced	**Why?** Rather spend more right from the start since it would in any case be required as the strategy is applied.	**Additional notes:**
22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		
Rating: Somewhat convinced	**Why?** These two concepts are married. It is integral to the solution.	**Additional notes:**
23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Convinced	**Why?** Detail of the business is important to establish absolute trust in the model.	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		
Rating: Convinced	**Why?**	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Somewhat convinced	**Why?** Must be part of the daily management to allow for access to transactional level results and to establish effectiveness.	**Additional notes:**
26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Somewhat convinced	**Why?** Must establish ownership and trust.	**Additional notes:**
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		

Rating: Somewhat convinced	**Why?** Convinced that the results will establish support.	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?** Must be user friendly in practice.	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: **Somewhat convinced**	**Why?** Must be limited and rather be developed by the analyst.	**Additional notes:**
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		
Rating: Convinced	**Why?** The only way to roll out and apply a strategy.	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		
Rating: Somewhat convinced	**Why?** Phase it in over a period of time. In the beginning more time must be allocated to system development.	**Additional notes:**
32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Not sure	**Why?** Rather emphasize business results than the performance of the individual.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Convinced	**Why?** Will move the management of the business to a new level.	**Additional notes:**
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		
Rating: Somewhat convinced	**Why?**	**Additional notes:**
35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?		
Rating: Somewhat convinced	**Why?** There are a number of other factors that influenced performance such as the market, turnover, range of inventory items etc.	**Additional notes:**
36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?		
Rating: Somewhat convinced	**Why?** The market plays an important role even if all the other aspects are in place.	**Additional notes:**

37. How convinced are you that the current price management decision process is sub-optimal?		
Rating: Not convinced	**Why?** Improved management is needed. Structure, policy and guidelines are required.	**Additional notes:**
38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?		
Rating: Convinced	**Why?** Gain control over margins, planning and pro-active corrections improve and increase immediately.	**Additional notes:**
39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?		
Rating: Not convinced	**Why?** Structure and policy is not effective. Must involve a specialist.	**Additional notes:**
40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?		
Rating: Convinced	**Why?** With system and structure as a basis the decision process will improve.	**Additional notes:**
41. How convinced are you that the Price Management System has been thoroughly considered?		
Rating: Convinced	**Why?** Perfect new model.	**Additional notes:**
42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?		
Rating: Convinced	**Why?** See question 41. Well thought through.	**Additional notes:**
43. Are you convinced that the proposed project team will be able to deliver on the project?		
Rating: Somewhat convinced	**Why?** If a very clear understanding of the business and practice is in place.	**Additional notes:**
44. Are you convinced that these are indeed the next steps to get the project going?		
Rating: Somewhat convinced	**Why?** If buy in on all levels is realized.	**Additional notes:**
45. How convinced are you that the delivery time frames are realistic?		
Rating: Somewhat convinced	**Why?**	**Additional notes:**
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Somewhat convinced	**Why?** Must grow market share first.	**Additional notes:**

47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		
Rating: Somewhat convinced	**Why?** Must thoroughly discuss this with the Subsidiary company's management and all factors must be highlighted.	**Additional notes:**

Table B.3: Qualitative feedback: Divisional operations director

B.1.4 Group company secretary (GCS)

1. How convinced are you that you should continue reading?		
Rating: Convinced	**Why?** Because previous exposure to data related initiatives (in the health care sector) has given me some insight into what is possible with effective data work.	**Additional notes:**
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		
Rating: Convinced	**Why?**	**Additional notes:**
3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Not sure	**Why?** Not sure how this will be implemented yet and what exactly these capabilities are.	**Additional notes:** Short example of what an advanced analytics application would be, how it will create a competitive advantage and the individuals that will make it happen must be included in this section to more clearly explain the concept of decision optimization.
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		
Rating: Somewhat convinced	**Why?** The history of the Holding Company's shareholding should be considered. The majority of our shareholders is not sophisticated and will not understand or appreciate this. In general - yes, it makes sense.	**Additional notes:** For the Holding Company or in general?
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Convinced	**Why?**	**Additional notes:**
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Convinced	**Why?**	**Additional notes:**

7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		
Rating: Convinced	**Why?**	**Additional notes:**
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		
Rating: Somewhat convinced	**Why?** It depends on how you structure the IT department. The existing IT staff could be skilled to accommodate some or all of the required competencies. Besides, who will be able to evaluate the work done by both departments better than one Senior Manager? There seems to be a large overlap between the two departments.	**Additional notes:**
9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Somewhat convinced	**Why?** Provided the manager also takes responsibility for IT.	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?**	**Additional notes:**
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Convinced	**Why?** The existing structure lacks these competencies.	**Additional notes:**
12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?**	**Additional notes:**
13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Convinced	**Why?**	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Convinced	**Why?**	**Additional notes:**
15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Convinced	**Why?**	**Additional notes:**
16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		

Rating: Convinced	**Why?** Not sure why this person should be a director	**Additional notes:** Why a director?
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Convinced	**Why?**	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		
Rating: Not sure	**Why?** Not sure what their functions are and why such a large department is required.	**Additional notes:**
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Somewhat convinced	**Why?** See question 18	**Additional notes:**
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Convinced	**Why?**	**Additional notes:**
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Not convinced	**Why?** Employees should not have the option to use or not to use certain applications. If the reasons behind the application are communicated clearly, employees should not resist using it.	**Additional notes:** Do not understand the difference between the deployment of specific applications as appose to the more general concept of deploying analytics.
22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		
Rating: Convinced	**Why?**	**Additional notes:**
23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Convinced	**Why?**	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		
Rating: Not sure	**Why?** Not sure what you are referring to.	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Convinced	**Why?**	**Additional notes:**

26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Convinced	**Why?** If user using the result - yes. They need to be involved in the process.	**Additional notes:** Business rules - Like what? Avoiding black boxes - what are these? Effectively dealing with incorrect model output - how will you know it is incorrect? Who is the user - user entering the data or user using the results?
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		
Rating: Convinced	**Why?**	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?**	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: Not sure	**Why?** People will by nature resort to their own judgment. There needs to be a "level-up" approval of any deviation without limiting the speed of decision making.	**Additional notes:**
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		
Rating: Convinced	**Why?**	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		
Rating: Convinced	**Why?**	**Additional notes:**
32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Not sure	**Why?** Time and effort should be spent on explaining the reasons for its applications but employees should not have the option not to use it. As mentioned before they will by nature revert to old ways and not trust a "machine" to make better decisions.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Convinced	**Why?**	**Additional notes:**
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		

Rating:	**Why?**	**Additional notes:**
Somewhat convinced		

35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?

Rating:	**Why?**	**Additional notes:**
Convinced		

36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?

Rating:	**Why?**	**Additional notes:**
Convinced		

37. How convinced are you that the current price management decision process is sub-optimal?

Rating:	**Why?**	**Additional notes:**
Convinced		

38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?

Rating:	**Why?**	**Additional notes:**
Convinced		

39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?

Rating:	**Why?**	**Additional notes:**
Convinced		

40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?

Rating:	**Why?**	**Additional notes:**
Convinced		

41. How convinced are you that the Price Management System has been thoroughly considered?

Rating:	**Why?**	**Additional notes:**
Convinced		

42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?

Rating:	**Why?**	**Additional notes:**
Convinced		

43. Are you convinced that the proposed project team will be able to deliver on the project?

Rating:	**Why?**	**Additional notes:**
Somewhat convinced	Depends on buy-in, available time, costs etc and the soft issues.	

44. Are you convinced that these are indeed the next steps to get the project going?

Rating:	**Why?**	**Additional notes:**
Convinced		

45. How convinced are you that the delivery time frames are realistic?

Rating:	**Why?**	**Additional notes:**
Convinced		
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Somewhat convinced	**Why?** I think there are other factors that could influence the outcome as well. For example strikes (labor unrest), slow economic growth, closing down of major clients and suppliers, and the subsidiary's own BEE Scorecard since this may influence the company's ability to tender.	**Additional notes:**
47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		
Rating: Somewhat convinced	**Why?** It is not without risk. The costs are really huge but the gains could also be huge.	**Additional notes:**

Table B.4: Qualitative feedback: Group company secretary

B.1.5 Investor (INV)

1. How convinced are you that you should continue reading?		
Rating: Convinced	**Why?** As part of its future strategy the Holding Company needs to improve it returns that it is generating for shareholders. The only possible way is to improve the components that make up the whole. Since its acquisition the Subsidiary Company has gone through a difficult period and any strategic tools will assist management in improving its financial position.	**Additional notes:** The respondent has been exposed to the successful application of advanced analytics in the financial services industry. This frame of reference had a positive impact on his assessment of the proposed advanced analytics strategy for the Holding Company and the Subsidiary.
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		
Rating: Convinced	**Why?** The better equipped a manager is the better he should be able to make informed, relevant and efficient decisions.	**Additional notes:**
3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Convinced	**Why?** In some of the investments this will be more relevant as the market changes very quickly and time is money.	**Additional notes:**
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		

Rating: Somewhat convinced	**Why?** I think that each company might be different. Service companies might be asset light. For me return on shareholder funds are the best benchmark because it indicates the use of resources, being funds and debt.	**Additional notes:**
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Convinced	**Why?** If all facts are known and some assumptions applied it should correlate. The only proviso is the acquired value that might impact market value and the strategic value for the current shareholder.	**Additional notes:** The respondent noted that he would appreciate an outline of the valuation methodology as well as a list of the assumptions on which the valuation model was based.
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Convinced	**Why?** Agreed with your arguments	**Additional notes:**
7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		
Rating: Convinced	**Why?** The more you equip a manager with strategic tools the better he should be able to perform.	**Additional notes:**
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		
Rating: Somewhat convinced	**Why?** You need to empower the managers of each of the underlying divisions, if it's all centralized you might create a new reporting layer.	**Additional notes:**
9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Convinced	**Why?** Person needs to have authority to be able to implement and execute.	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?** Need buy-in from everybody to be successful.	**Additional notes:**
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Somewhat convinced	**Why?** Needs to be driven which begins from the top down.	**Additional notes:**
12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?** How else could It become relevant?	**Additional notes:**

13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Convinced	**Why?**	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Convinced	**Why?** If you want a high impact solution, optimization modeling skills are a must.	**Additional notes:**
15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Somewhat convinced	**Why?** I am unsure as to what is currently used and what will be required. If the investment creates savings of four times the capital outlay then this will make sense.	**Additional notes:**
16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		
Rating: Convinced	**Why?** If you want to escalate the importance you would need to have direct feedback to the CEO.	**Additional notes:**
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Convinced	**Why?** How else would you implement the plan?	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		
Rating: Not sure	**Why?** The structure will be based on what is the best solution for the Holding Company. I am not familiar with the proposed structure.	**Additional notes:**
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Not sure	**Why?** Same comments as in question 18. The cost implication is significant. We would need to see some form of return. I agree with the concept but not the total expense.	**Additional notes:**
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Convinced	**Why?** Agree that efforts should be focused on what needs to be improved.	**Additional notes:**
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Somewhat convinced	**Why?** Needs to balance the two. Costs vs. Improvement.	**Additional notes:**

22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		
Rating: Convinced	**Why?**	**Additional notes:**
23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Convinced	**Why?**	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		
Rating: Convinced	**Why?**	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Convinced	**Why?** It needs to part of the current business practices otherwise you might duplicate or loose effectiveness.	**Additional notes:**
26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Somewhat convinced	**Why?** It is important but in certain cases confidentiality might be compromised.	**Additional notes:**
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		
Rating: Somewhat convinced	**Why?** What about ownership of information or incorrect assumptions or inputs?	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?**	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: Somewhat convinced	**Why?** What if the problem is the manager's lack of experience or poor judgment? This needs to be moderated.	**Additional notes:**
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		
Rating: Convinced	**Why?** Without the support you are dead in the water. They will be the users and will receive the praise or the scorn if the system is not working.	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		
Rating: Not sure	**Why?** Don't know.	**Additional notes:**

32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Somewhat convinced	**Why?** Agree but will only have an impact if it is measurable and defined.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Convinced	**Why?**	**Additional notes:**
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		
Rating: Not sure	**Why?** The impact of management changes as well as the economic downturn is ignored.	**Additional notes:**
35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?		
Rating: Not sure	**Why?** Lost market share or fighting for market share could also cause this. Management must be a big reason for the company's decline.	**Additional notes:**
36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?		
Rating: Somewhat convinced	**Why?** Marketing, distribution and procurement also play a big part.	**Additional notes:**
37. How convinced are you that the current price management decision process is sub-optimal?		
Rating: Convinced	**Why?** Your arguments are well motivated. Consideration should also be given to changing the customer profile. If you want to play in the tender market your tools need to support this model.	**Additional notes:**
38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?		
Rating: Somewhat convinced	**Why?** Market conditions would need to be included into the mix. Management experience as well.	**Additional notes:**
39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?		
Rating: Not sure	**Why?** What about an analysis by product? Why did the system work when the previous owners led the company?	**Additional notes:**
40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?		

Rating: Somewhat convinced	**Why?** Other elements will have a bigger impact like the exchange rate or tender market. Don't know if this will work with tender market.	**Additional notes:**
41. How convinced are you that the Price Management System has been thoroughly considered?		
Rating: Convinced	**Why?** Very good analysis!	**Additional notes:**
42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?		
Rating: Convinced	**Why?**	**Additional notes:**
43. Are you convinced that the proposed project team will be able to deliver on the project?		
Rating: Convinced	**Why?**	**Additional notes:**
44. Are you convinced that these are indeed the next steps to get the project going?		
Rating: Convinced	**Why?**	**Additional notes:**
45. How convinced are you that the delivery time frames are realistic?		
Rating: Not sure	**Why?** I have not been exposed to this in the past.	**Additional notes:**
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Somewhat convinced	**Why?**	**Additional notes:**
47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		
Rating: Somewhat convinced	**Why?**	**Additional notes:**

Table B.5: Qualitative feedback: Investor

B.1.6 Non-executive director (NED)

1. How convinced are you that you should continue reading?		
Rating: Somewhat convinced	**Why?** Well, if something could increase the shareholder value by R20 million and I can be part of the reason then why not?	**Additional notes:**
2. Are you convinced that the ability to optimize decision processes represents a competitive advantage?		

Rating: Somewhat convinced	**Why?** Only if one's competitors are not able to do it.	**Additional notes:**
3. Are you convinced that a sustainable competitive advantage can be created by developing capabilities that allow the Holding Company to optimize its key decision processes?		
Rating: Somewhat convinced	**Why?** If the capabilities are developed then I think that a competitive advantage could be created as "I think" (not sure) our competitors do not use or make use of them.	**Additional notes:**
4. How convinced are you that Intrinsic Value should be used to measure the impact of advanced analytics initiatives?		
Rating: Not sure	**Why?** I thought that the advanced analytics initiatives would be used by management in their organization decision making. This would hopefully lead to positive results, but the results should be far better than any competitor due to the competitive advantage that is obtained. If the Holding Company was able to generate exceptional returns, but due to our shares being not so liquid in trading terms then our share price would most likely be trading at a much higher price as the demand would be high and the supply would be under pressure.	**Additional notes:**
5. How convinced are you that intrinsic value is a strong predictor of market value and therefore shareholder value?		
Rating: Somewhat convinced	**Why?** I am not sure that there are many investors that make use of analytics techniques in order to estimate the intrinsic value of the Holding Company's shares. Our major shareholder would be one, but the rest or most of the shareholders have inherited their current investment. Therefore, I agree with the statement, but not sure how applicable it is in our current shareholder profile.	**Additional notes:**
6. How convinced are you that decision optimization will lead to an increase in shareholder value?		
Rating: Convinced	**Why?** Good decisions by management and board will result in positive returns. Those returns will show a positive economic profit. This will over time increase the demand of our shares and as the share prices increase the share value will have increased.	**Additional notes:**
7. How convinced are you that the lack of decision quality represents a real opportunity for performance improvement?		

Rating: Convinced	**Why?** Bad decisions will lead to poor outcomes. Therefore if one can make sound decisions there will be an obvious improvement in performance.	**Additional notes:**
8. How convinced are you that the company needs to set up a centralized analytics department separate from the IT department?		
Rating: Not sure	**Why?** Surely the IT department and finance should be closely linked to it if it was implemented.	**Additional notes:**
9. How convinced are you that the company should appoint a senior manager to drive the analytics agenda in the company?		
Rating: Somewhat convinced	**Why?** It would be important for someone to drive the initiative otherwise lots of data could be generated with no focus and people would not understand the reasoning behind many reports etc.	**Additional notes:**
10. How convinced are you that establishing an analytics culture in the company will be important for the successful application of advanced analytics?		
Rating: Convinced	**Why?** People must believe in something otherwise it will not really work.	**Additional notes:**
11. How convinced are you that the most effective way to establish such a culture could be through the appointment of a senior manager who must drive the analytics agenda?		
Rating: Somewhat convinced	**Why?** As per Questions 9 and 10, need a driver.	**Additional notes:**
12. Are you convinced that the analytics department must have business insight to effectively deliver value to the company?		
Rating: Convinced	**Why?** Otherwise how will they know what should be analyzed or how to interpret the results that were obtained.	**Additional notes:**
13. Are you convinced that the best way to gain this insight is to employ or develop value management skills?		
Rating: Convinced	**Why?** As per question 12	**Additional notes:**
14. Are you convinced that optimization modeling is a critical component of the skill set of an analytics department focused on decision optimization?		
Rating: Convinced	**Why?** Some models will not give the best results or will give results that will be difficult to interpret therefore you would want the department to have sound "model selection" skills.	**Additional notes:**
15. Are you convinced that the company will have to invest in an analytics platform?		
Rating: Convinced	**Why?** If it was the decision to take the route of an analytical department then I think a platform would need to be created.	**Additional notes:**

16. Are you convinced that the newly created senior management role should report directly to the Group Managing Director?		
Rating: Somewhat convinced	**Why?** IT is becoming such an important part of our business that the person could well fit into the proposed structure. Otherwise an alternative would be to have a senior manager under the Group Financial Director. Another suggestion would be for the two managers to report to the GFD, an analytics manager and an IT/Finance manager.	**Additional notes:**
17. Are you convinced that the IT manager and the Analytics Department Manager should both report to the newly created senior position?		
Rating: Somewhat convinced	**Why?** See Question 16.	**Additional notes:**
18. Are you convinced that the proposed department structure is best aligned with the focus on decision optimization?		
Rating: Not sure	**Why?** Not sure as I do not know enough to make a valued decision at this point in time.	**Additional notes:**
19. Are you convinced that it makes sense for the Holding Company to commit to an additional R5.5 million in personnel costs?		
Rating: Not sure	**Why?** I think that a sudden investment would have to be investigated further as this does not include the analytical platform etc.	**Additional notes:**
20. How convinced are you that the best approach to data is to concentrate data management efforts on the data requirements of specific analytics applications?		
Rating: Convinced	**Why?** Managers of various companies often are unsure of what they need to make a decision or more often how to get the information. So it is a combination of both.	**Additional notes:**
21. How convinced are you that high value impact analytics solutions must have specific characteristics bearing in mind that it will increase the development costs?		
Rating: Convinced	**Why?** I think it is self explanatory. The better the quality of the application it would most likely take longer to develop resulting in further man-hours etc.	**Additional notes:**
22. Are you convinced that business relevance is an important characteristic of high value impact analytics solutions?		
Rating: Convinced	**Why?** Well if it is of no business relevance what would its purpose be then?	**Additional notes:**

23. Are you convinced that an in depth understanding of the proposed and current decision processes is vitally important when developing analytics applications that are business relevant?		
Rating: Not sure	**Why?** What about what are the current needs of decision makers? Surely the proposed and current decision processes would change due to a "successful" analytical department	**Additional notes:**
24. Are you convinced that the proposed decision analysis framework will provide the analyst with the required level of insight to develop business relevant solutions?		
Rating: Somewhat convinced	**Why?** An in depth understanding of the proposed and current decision processes will give insight into developing business relevant solutions.	**Additional notes:**
25. How convinced are you that the advanced analytics application must be integrated with current business processes?		
Rating: Convinced	**Why?** I do not think they will be as effective if they are not part of the business process.	**Additional notes:**
26. How convinced are you that application transparency plays a direct role in the level of user acceptance of the application?		
Rating: Convinced	**Why?** If the logic cannot be explained then the solution may well not actually be achievable.	**Additional notes:**
27. Are you convinced that the proposed approach will indeed deliver the level of transparency that is required?		
Rating: Not sure	**Why?** Why? What is a black box solution? Not sure how transparency is realized by effectively dealing with potentially incorrect model output. Need to discuss this question further.	**Additional notes:**
28. Are you convinced that easy to use applications are absolutely integral to the successful deployment of analytics in the business?		
Rating: Convinced	**Why?** If something is very complicated it will not be supported.	**Additional notes:**
29. How convinced are you that allowing a user to override the application will contribute to its acceptance and use?		
Rating: Convinced	**Why?** Ultimately human judgment is still a necessary path to ensure the success. If one can justify one's decision with a logical explanation even though it overrides the application then that should be sufficient.	**Additional notes:**
30. Are you convinced that getting front line staff and managers to commit to the proposed systems will require dedicated effort?		

Rating: Convinced	**Why?** Anything new and which is different is usually seen as a hurdle. If it is very difficult it could be a mountain, i.e. the required dedicated effort will increase.	**Additional notes:**
31. Are you convinced that at least 50% of project resources should be allocated to ensuring front line commitment?		
Rating: Not sure	**Why?** Do not have enough information to give a valued answer.	**Additional notes:**
32. How convinced are you that specific incentives should be put in place to support commitment?		
Rating: Not sure	**Why?** If it is a management and board decision to implement then employees are already getting paid to do their designated work. If it is similar to giving incentives to employees to be on time for work then I do not agree with it.	**Additional notes:**
33. Are you convinced that considerable effort should be focused on the development and delivery of training programs to ensure effective usage of the proposed applications?		
Rating: Convinced	**Why?** If it is technical and difficult to sue then training programs will be important.	**Additional notes:**
34. How convinced are you that the preceding section accurately represents the historical value creating ability of the Subsidiary Company?		
Rating: Not convinced	**Why?** I think it reflects none of the historical performance, but having said that one of the main problems was that the GP% declined rapidly and we purchased other businesses at inflated prices. It increased our asset base considerably, but these acquisitions were generating much lower returns and as a result our ROIC declined over time.	**Additional notes:**
35. How convinced are you that the declining gross profit margin and increasing working capital contributed to the weak value creating performance of the Subsidiary Company over the past four years?		
Rating: Convinced	**Why?** Discussed in Question 34	**Additional notes:**
36. How convinced are you that Subsidiary Company's value creating ability will dramatically improve by focusing on pricing, inventory acquisition costs and inventory holding levels?		
Rating: Convinced	**Why?** But new markets will have to be found to ensure growth.	**Additional notes:**
37. How convinced are you that the current price management decision process is sub-optimal?		

Rating: Somewhat convinced	**Why?** If there is too much variation in price it results in varied GP%. I think prices should be set and volume discounts should be the exception or large customers that purchase small quantities but frequently should have reduced prices. These accounts should be managed to ensure that customers are being priced correctly.	**Additional notes:** Similar to Discovery Virgin Active. You get reduced rates if you frequent the gym regularly. If you don't your rates go up. The same goes for a customer that is not buying according to his original profile.
38. How convinced are you that the proposed intervention will dramatically improve the quality of the price management decision process?		
Rating: Convinced	**Why?** If the integrated price management system is correctly developed it will automatically increase the GP% f the company.	**Additional notes:**
39. How convinced are you that the current inventory acquisition and management decision process is sub-optimal?		
Rating: Somewhat convinced	**Why?** It is a concern at board level. As a director of the subsidiary company I continuously question our stock levels with management.	**Additional notes:**
40. How convinced are you that the proposed intervention will dramatically improve the quality of the inventory acquisition and management decision process?		
Rating: Convinced	**Why?** If it leads to reduced inventory holding at a reduced cost it will result in greater returns to the company.	**Additional notes:**
41. How convinced are you that the Price Management System has been thoroughly considered?		
Rating: Somewhat convinced	**Why?** Various options have been considered.	**Additional notes:**
42. How convinced are you that the proposed Inventory Acquisition and Management Application has been thoroughly considered?		
Rating: Somewhat convinced	**Why?** Considerable investigation has been done.	**Additional notes:**
43. Are you convinced that the proposed project team will be able to deliver on the project?		
Rating: Somewhat convinced	**Why?** All role players are participant.	**Additional notes:**
44. Are you convinced that these are indeed the next steps to get the project going?		
Rating: Convinced	**Why?** Thought it was inventory optimization. Read the question again. (Good idea.)	**Additional notes:** Scratched out: Should the model not start at Epping. One could start here as much of the inventory is distributed from here.
45. How convinced are you that the delivery time frames are realistic?		

Rating: Not sure	**Why?** Not sure, but does not seem unreasonable.	**Additional notes:**
46. Are you convinced that the Subsidiary Company Decision Optimization Project can increase shareholder value by between R30 million and R50 million?		
Rating: Not sure	**Why?** If the system works at branch level then it will work for the whole of the Subsidiary Company. That improvements can be obtained is definitely so. Will R30m to R50m be obtained? Well proof will be in the implementation.	**Additional notes:**
47. How convinced are you that the Holding Company should implement the complete advanced analytics strategy?		
Rating: Not sure	**Why?** I think it should be done for the Subsidiary Company, but not quite sure if the Holding Company should invest in it right now. Therefore, personally I think there is scope to downscale the initial investment and to focus on the Subsidiary Company. Depending on the success this could grow to incorporate the whole group of companies.	**Additional notes:**

Table B.6: Qualitative feedback: Non-executive director

B.2 Quantitative feedback

Question	GMD	GFD	DOD	GCS	INV	NED
1	4	4	4	4	4	3
2	4	3	3	4	4	3
3	4	2	3	2	4	3
4	3	2	2	3	3	2
5	4	4	2	4	4	3
6	4	3	3	4	4	4
7	4	4	4	4	4	4
8	1	1	3	3	3	2
9	1	1	3	3	4	3
10	4	4	4	4	4	4
11	1	2	4	4	3	3
12	4	4	4	4	4	4
13	1	4	4	4	4	4
14	4	4	3	4	4	4
15	1	4	3	4	3	4
16	4	2	4	4	4	3
17	1	3	3	4	4	3

Question	GMD	GFD	DOD	GCS	INV	NED
18	2	2	2	2	2	2
19	1	1	2	2	2	2
20	4	4	3	4	4	4
21	3	4	3	1	3	4
22	4	4	3	4	4	4
23	3	4	4	4	4	2
24	1	2	4	2	4	3
25	4	4	3	4	4	4
26	3	4	3	4	3	4
27	2	4	3	4	3	2
28	4	4	4	4	4	4
29	4	4	3	2	3	4
30	4	4	4	4	4	4
31	4	3	3	4	2	2
32	1	2	2	2	3	2
33	4	3	4	4	4	4
34	4	3	3	3	2	1
35	4	4	3	4	2	4
36	4	4	3	4	3	4
37	4	3	1	4	4	3
38	4	2	4	4	3	4
39	4	3	1	4	2	3
40	4	4	4	4	3	4
41	4	1	4	4	4	3
42	4	1	4	4	4	3
43	4	2	3	3	4	3
44	3	2	3	4	4	4
45	3	2	3	4	2	2
46	4	2	3	3	3	2
47	3	2	3	3	3	2

Table B.7: Quantitative feedback: All respondents